SCIENTIFIC AMERICAN

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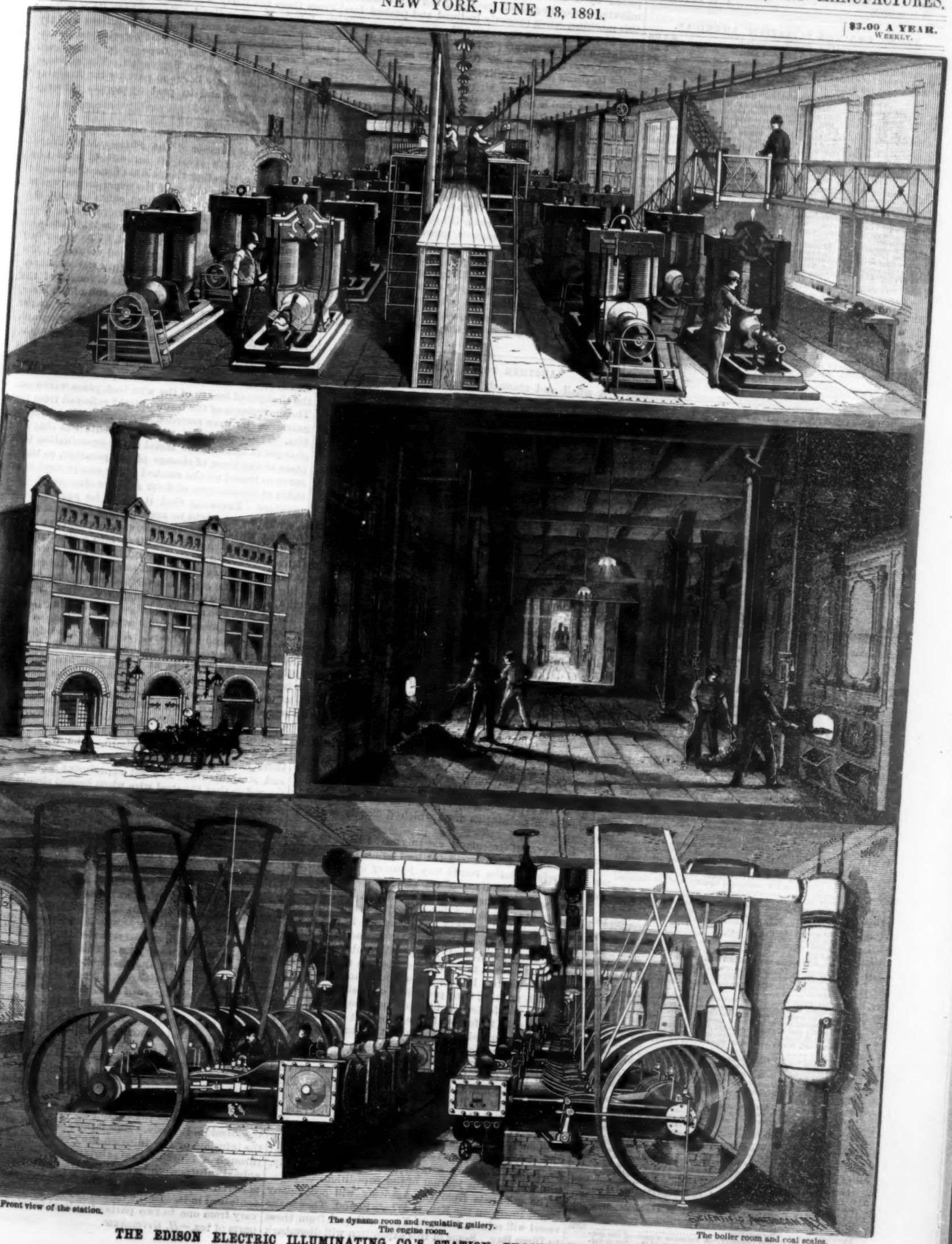

Front view of the station.

The dynamo room and regulating gallery.

The engine room.

The boiler room and coal scales.

THE EDISON ELECTRIC ILLUMINATING CO.'S STATION, BROOKLYN, N. Y.—[See page 373.]

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MAXIM'S FLYING MACHINE.

Mr. Hiram Maxim, well known for his many ingenious inventions, who is, moreover, a very practical and successful mechanic, has for some time past devoted considerable study to the subject of aerial navigation. His practical experiments in this direction, which have been many and various, appear to have crystallized into the form of a machine which might be called a steam kite. The experimental device consists of a thin sheet or kite 4 ft. wide and 18 ft. long, which is propelled by a screw capable of 3,500 revolutions per minute. According to information given by Mr. Maxim this machine, when properly inclined and pushed forward by the screw at the rate of 30 miles per hour, will maintain itself in the air; if the forward speed is increased to 35 miles per hour, it begins to ascend; at 90 miles its rising power is quite strong.

Mr. Maxim says he has already expended $45,000 on these tests, and is now at work on a large machine of silk and steel, with a plane 110 ft. by 40 ft., with two wooden screws 18 ft. in diameter. A petroleum condensing engine will furnish the power. In his previous experiments he found that one horse power would carry 133 pounds 75 miles per hour. He had proved that the screw would lift forty times as much on the propelled plane as it could push. A motor he says has been built, weighing 1,800 pounds, which pushes 1,000 pounds, and will consequently lift 40,000 pounds. The estimated weight of his engines, generator, condenser, water supply (2 gallons), petroleum (40 pounds per hour) and two men is about 5,000 pounds. Thus with a steam kite weighing in all 6,800 pounds he calculates on having an ascending power equal to 40,000 lb., or 33,200 pounds more than the dead weight, say eleven tons. It is devoutly to be hoped that Mr. Maxim will soon be able to demonstrate the success of his great passenger kite.

ANOTHER POLAR EXPEDITION.

A small and staunch steam vessel, the brigantine Kite, sailed from New York June 6 for Whale Island, on the west coast of Greenland, 77 degrees and 20 minutes north latitude. The vessel had on board Lieut. Peary, of the United States Navy, his wife, and five men, who designed making from that point an overland exploration, in a northeasterly course, to as high latitudes as possible, determining, if practicable, the northern coast line of Greenland, and acquiring all obtainable information relative to the polar seas. Explorers have many times been much further north along the coast line, and no great difficulty is anticipated in reaching the point sailed for, at the foot of Humboldt Glacier, about the middle of July. Here the coast is bordered by mountains, which it is the intention of Lieut. Peary to climb, carrying his sledges and abundant supplies, with the idea that he will then be at the surface of a great ice plateau, which he intends to make his highway to the far north.

It is the intention of the explorer to get well established in winter quarters before the four months' season of darkness and extreme cold sets in, and supplies sufficient to last the party for three years have been taken, although it is said that game is abundant in that section. With the northward movement of the sun in the spring, the real work of the expedition will commence, the journey northward being made on snow shoes and with sledges. It matters not how deep the snow may be, in Lieut. Peary's opinion, and he is an experienced snow traveler, counting "deep, soft snow as the perfection of roads," but chasms and ragged ice, which he expects mainly to avoid in the route chosen, are the only obstacles from which difficulty is anticipated.

But, even if Greenland extends only a little way beyond Lieut. Lockwood's furthest point, Lieut. Peary has before him a round trip journey of about 1,200 miles. Just as Nansen traveled, now over a hard crust, and then through deep, soft snow, Lieut. Peary is likely at times to find sledge hauling very hard work. Gen. Greely believes that the inland ice is not coterminous with the north coast of Greenland; and if this theory is correct, Lieut. Peary will probably find it difficult to reach the north coast by the route he proposes, for he and his comrades could not travel far overland, packing their provisions on their backs. At any rate, if defeated in his main purpose, he will perhaps be able to follow the ice edge east to the east coast, and completely determine the northern extension of the great ice cap of Greenland.

There is also aboard the Kite another party known as the West Greenland Exploring Expedition, of the Academy of Natural Sciences, of Philadelphia. This party consists of Prof. Angelo Heilprin, leader and geologist; Prof. Benjamin Sharp and Prof. J. F. Holt, zoologists; Dr. William E. Hughes, ornithologist; Dr. William H. Burk, botanist, and correspondent of the Philadelphia *Ledger;* Levi W. Mengel, entomologist; Dr. Robert M. Keely, surgeon; Alexander C. Kenealy, who will keep the journal of the expedition.

The scientists from the Academy will accompany Lieut. Peary on the Kite to Whale Sound. Thence the vessel will return direct to Upernavik and from there to Disco Bay. Some of this expedition will disembark there; others will cruise on the Kite in whatever direction seems best to them to obtain the information they seek.

The land division will explore the interior of the country, in particular an unnamed mountain back of Disco Bay, of which geographers know nothing, of whose denizens zoologists and of whose flora botanists are ignorant. Returning southward, several fiords will be explored, and the height of glaciers be determined as accurately as possible.

Near Godshaven there is another unnamed and unknown mountain which will be climbed and examined. From there the party will go to Ivigtut, and thence to St. John's, Newfoundland. Everywhere its members will make zoological and botanical collections and try to inform themselves of Greenland's geological formation. The last named party hope to be home again about the middle of next September. The expenses of both expeditions are borne in part by the Academy of Natural Sciences and in part by private subscriptions.

Recalescence in Steel and Iron.

In the current number of the *Philosophical Magazine* Mr. F. J. Smith gives an account of some new methods of investigating the points of recalescence in steel and iron. The object of the experiments was to discover the time connection which exists between the change of form and the change of temperature. Several methods of experimentation were tried, and the following was the one fiually adopted. The upper end of the steel wire to be tested was fixed vertically; the lower end was attached to a long light lever of aluminum, so arranged that a small change of length of the wire caused a large movement of the end of the lever, which traced a line on the smoked surface of paper rotating on an ordinary physiological chronograph cylinder. A platinum-platino-rhodium thermo-couple, twisted round the wire where it was heated, was in circuit with a Deprez-D'Arsonval galvanometer. By means of this combination the temperatures at which the changes of length of the wire took place were read. The movements of the beam of light reflected from the galvanometer were recorded on a moving photographic film. The outcome of the experiments was that the changes of form of the metal under examination took place at the times of change of temperature, so that a curve so traced on the smoked paper can be used as an index of the changes of form and the changes of temperature. Thinking that it might be probable that these changes might be accompanied by some sounds at the critical points, the following apparatus was constructed: A mica disk was fitted into a circular recess turned out of a piece of wood. The steel wire under examination was attached at one end to the center of the disk, at the other to a vertical post. The front of the recess into which the mica disk was fitted was furnished with two sounding tubes. On heating the wire a certain temperature was reached at which a sharp crackling sound was heard. As the temperature was increased this ceased; then, on removing the flame, at the same temperature at which the first sound was heard, a second similar sound occurred. This took place at the point of recalescence. As the wire cooled this ceased, and then, when a temperature of about 490° C. was reached, a very sharp sound was emitted. This third sound appears to take place at the second critical point observed by M. Osborn. The wire used in these experiments was steel pianoforte wire, annealed and straightened. The last experiment was also arranged so that the steel wire when heated should be in a strong magnetic field. Repeated trials showed that the sounds produced were in no way altered by the fact of the wire being in the magnetic field.

Lead Pipe Pierced by an Insect.

K. Hartmann, in *Gesundheits Ingenieur*, January 15, 1891, relates a case in which a lead pipe was cut through by an insect that was actually found with its head in the hole pierced by it. A workman was called in to repair a defective pipe which had been injured on a previous occasion, as was reported, by a "nail hole" occurring in a soldered joint. This time the worm (a wood wasp) causing the mischief was found *in situ*. The hole on the exterior of the pipe was of a rounded form, about one-quarter of an inch long by one-eighth inch wide, and the penetration was through the entire thickness of the metal. Though of rare occurrence, well authenticated instances of similar injuries by insects are on record.

THE tannin present in tea is absorbed by suitable animal substances, such as horn shavings, dried albumen, hide clippings, and the like. It is preferable to add the material to the tea in the dry condition before the infusion is made. But it may also be added to the infusion, or the infusion may be passed or filtered through a layer of the substance. The quantity of animal substance to be added to the tannin-containing material must be determined by the amount of tannin contained in it. In the case of tea the proportion may vary from one to two parts of animal substance to ten parts of tea.—*H. Grimshaw.*

THE "ARROW WEED" AND MEXICAN "JUMPING BEANS."

It has long been known that the Indians in Mexico make a powerful poison from some native plant, which poison, in a milder form, is also used as a cathartic. It has also long been known that seeds possessing the curious power of jumping are produced upon the same plant in Mexico and are sent to other parts of the world, forming quite an article of commerce. The exact nature of this plant, however, has hitherto remained a mystery. At a recent meeting of the Washington Entomological Society, Professor C. V. Riley read an interesting paper on the determination of the plant upon which these "jumping seeds" are produced. In the Transactions of the St. Louis Academy of Science for 1875, in an account of *Carpocapsa saltitans*, Westwood, the insect which causes the saltations of the "beans," he had called attention to the fact that the particular euphorbiaceous plant upon which these seeds are produced was not determined. Westwood in his original description of *Carpocapsa saltitans* states that the plant is known to the Mexicans as *Colliguaja*, and in a recent letter to Professor Riley from M. Chretien, of the French Entomological Society, the plant was referred to as a Mexican euphorbiaceous plant called *Colliguaja odorifera*, Moline. About this time Mr. J. M. Rose, of the botanical division, brought to Professor Riley specimens of plants recently collected by Dr. Edward Palmer, who sent with the plants specimens of the capsules, thus rendering it certain that the jumping bean occurs on this particular plant. It turned out to be undescribed, has been referred to the genus *Sebastiania*, and will be described by Mr. Rose as *S. palmeri*. Professor Riley decides that the reference given by M. Chretien is erroneous, as Bentham and Hooker give *Colliguaja odorifera* as from South America, and there is no record of it as from Mexico. Comparison of the specimens in the Department herbarium showed that while evidently closely allied, *Colliguaja* is quite distinct from *Sebastiania*, which renders it rather remarkable that the name given by the Mexicans to the plant should be identical with that adopted for the South American genus. The name seems to be of Chilean origin, and was doubtless introduced into Mexico by the Spaniards. It is doubtless applied to various euphorbiaceous species having the same poisonous attribute, whether occurring in Mexico or south of the equator.

A closely allied species of *Sebastiania* from the same localities (as yet undescribed, but which Professor Watson will describe as *S. pringlei*) also shows evidence of being infested with *Carpocapsa saltitans*, and a third species (*S. bilocularis*, Watson) is infested by an allied larva of a moth which Professor Riley describes by the name of *Grapholitha sebastianiæ*. There is therefore good evidence that the insect causing the saltations of the "beans" develops in the capsules of as least two different species of the genus *Sebastiania*. The young larva doubtless hatches from an egg laid externally on the capsule, and penetrates the same while quite young, very much as in the case of the common pea weevil. Dr. Palmer found *S. palmeri* only in certain canons near Alamos, where it is popularly known as *palo de la flecha cuero de las simellas, brincaderos* (arrow tree which produces the jumping beans). The plant exudes a good deal of milky juice, which is what the Indians use on their arrow heads. It is a loose-growing shrub, from 5 to 8 feet high, the wood very hard, and the milky juice readily crystallizing into a clear, white, brittle substance. In the appearance of the wood it reminds one somewhat of our witch hazel, and in the leaf of a broad-leaved willow. As in the case of other Euphorbiaceæ, the carpels, or each of the three parts of the capsule, dehisce, or suddenly split when ripe, but when the larva inhabits the same, the parts fail to separate, being kept together by the carpet of silk which the larva spins on the inside. The peculiar jumping motions of the carpel are thus produced, as first described by Professor Riley in the Transactions of the St. Louis Academy aforementioned. The full grown larva, by its holding fast to the silken lining by its anal and two hind pair of abdominal pro-legs, which have very strong hooks, then draws back the head and forebody, the thoracic parts swelling and the thoracic legs being withdrawn. The contracted parts being then suddenly released, the larva vigorously taps the wall of its cell with the head, sometimes thrown from side to side but more often brought directly down, as in the motion of a woodpecker when tapping for insects. The seed will thus move whenever warmed for several months during the winter, because, as with most tortricid larvæ, this one remains a long time in the larval state after coming to its growth and before pupating.

Remarkable as are the movements of this seed, Prof. Riley remarked that they are thrown into the shade by a little jumping gall produced on the leaves of our post oak and other oaks. This is a little spherical seed-like gall, and the insect within, and which produces the fly known as *Cynips saltatorius*, can make it bound twenty times its own length. Here the motion is imparted by the insect in the pupa and not in the larva state.

THE MANUFACTURE OF BIRCH OIL.

A profitable industry, and one of which but little is known to the world at large, is carried on among the hills of New England. It is the manufacture of birch oil, and five years ago it was an industry that paid the limited number of men engaged in it a very handsome return for their labor, but the placing upon the market of an adulterated oil has cut down the price of the pure article, and now the manufacturer fails to realize the liberal reward for his labor that he did formerly.

Birch oil has a market value as a flavor. It is used largely in the manufacture of confectionery and is sold, almost invariably, under a label that calls for the essence or extract of wintergreen. Pure extract or essence of wintergreen does not exist, nor is there any need of it, for the clarified oil of birch gives one a perfect wintergreen flavor, and it is so pungent that the smallest drop placed upon the tongue will blister it.

The manufacture of pure birch oil is now confined to the State of Connecticut, where there are eight mills now in operation. Ten years ago the industry was known only in Pennsylvania, and all the birch oil marketed passed through the hands of one wholesale drug firm in Philadelphia. The increased demand for the oil resulted in its adulteration, and in the manufacture by a company of German chemists in Philadelphia of what is known to the trade as a synthetic oil.

Ten years ago hardly anything was known of the manufacture of birch oil outside of Pennsylvania, and the secret of clarifying the oil was known to only a very few. About that time Rev. Tom Dickerson, of Essex, Connecticut, saw an opportunity to turn the vast forests of birch that crown the hills of New England into profitable use, and he sent his son to Pennsylvania for the purpose of learning the process of manufacturing the oil. The son secured a position in a birch mill, where he worked eighteen months, and during that time he had got an idea of how the work was done, and he managed to learn what chemicals were used in clarifying the oil. With this knowledge young Dickerson returned to Connecticut and engaged with his father in the manufacture of the first birch oil ever extracted east of the Keystone State.

The first birch mill was built at Joshuatown, a delapidated hamlet on the Connecticut River, nearly opposite Essex, and there Tom Dickerson & Son began the work that in three years gave them both an independent fortune. The success of the shrewd minister stirred the blood in the veins of some of the observing Yankees, and within two years there were six birch mills in operation within a radius of ten miles of Joshuatown, and this number has increased to eight. Although the clarifying of the oil is not an open secret, it is known to a large number of men who are engaged in the business.

With a capital of twenty-five hundred dollars a man can set up his plant and begin the manufacture of birch oil. The best and most profitable mills are equipped with six water-tight wooden tanks, about six feet square. In some cases these tanks are so built that a fire may be set under them for the purpose of boiling the water that they contain. These tanks have copper bottoms. In many of the mills the work is done by steam, and in such cases there must be a furnace and boiler, and a coil of steam pipes is laid in the bottom of each tank. With tanks, pipe, boiler, a few glass jars, and a good supply of fresh, cold water the manufacturer is ready for business.

The farmers are paid three dollars a ton for birch brush that must not be more than two and a half inches in diameter, and the only variety of birch used is the black, mountain, or sugar birch. From the yellow and white birch no oil can be extracted.

If the farmer does not live more than six miles from the mill, he can, by working early and late, manage to cut and haul to the mill one ton a day. This, to the average New England farmer, is very profitable work, and the building of birch mills in their midst has been of great benefit to a large number of them. Many of these men who have birch to sell are not so favorably located as others. There are many men who drive a slow-going ox team to the mill with but half a ton of brush, and the distance that they travel going and coming is more than twenty miles. Their compensation for the day's labor of three yoke of oxen and themselves is one dollar and fifty cents, but these men are satisfied with that, and in most cases their farms are clear of mortgage and they are not indebted to the village storekeeper.

The brush is chopped into pieces of from one and a half inches to five inches long, by a heavy machine built with heavy knives, on the principle of a hay cutter. One ton of brush can be run through a cutter in an hour if kept steadily running.

These short pieces are thrown into the tanks, in which about a foot and a half of water has been placed, the fire is then built or the steam turned on and the water set a-boiling. While the water is being heated, the covers of the tanks are shut and "plastered" or sealed around the edges with rye flour paste. This is to prevent the steam from escaping.

The water in each tank is kept at a boiling point six hours, at the end of which time the life of the birch is extracted.

Entering each tank near the top is an iron pipe, through which the steam escapes and passes through a coil placed in a barrel that is kept full of running water. In this manner the steam is condensed and drops into a glass jar, placed under a pipe at the bottom of the coil, for its reception.

Birch oil in a pure state is much heavier than water. Thirteen fluid ounces weigh a pound, and instead of rising to the top of the condensed steam, it settles to the bottom of the jar, where, in its action when the jar is moved, it very much resembles quicksilver.

In its crude state the oil is of a copper hue. If boiled in tanks with copper bottom, or if cooked over a steam coil, it is of the darker hue of iron. The most popular and the cheapest method of clarifying the oil is as follows:

The oil in its crude state is poured upon a woolen blanket that is then laid upon the top of the brush in a tank. The covers are "plastered" down and the water set a-boiling. The steam passes through the blanket, which absorbs the particles of copper and iron, and the oil drops into the receptacle at the bottom of the worm of a hue that is a very light green or like the essence of lemon. Clarifying the oil by the use of chemicals is much more expensive and generally less satisfactory.

A tank six feet square will hold a ton of brush and each ton yields four pounds of oil. The mills are run during the season, night and day, and each tank is filled three times. The daily product of a six-tank mill is about seventy-five pounds of oil per day. Five years ago, the oil brought three dollars and fifteen cents a pound readily, but now the price is one dollar and a half a pound, but even at this reduced figure the birch oil manufacturer is able to pay his running expenses and make a neat income besides.

The product of the eight mills in Connecticut is handled by one firm in Essex, Connecticut. The mills do not run during the summer, because of the trouble of preparing the brush for the cutter, it being necessary to remove the foliage. The season opens about the first of October and the mills run until the last of April.

The oil of birch in an adulterated form is used in tanning leather to imitate Russia leather, which has a very peculiar odor. For a long time tanners were at a loss how to give American hides this odor. They finally discovered that birch oil would do it, and now a great deal of it is used for that purpose.

Further information on the subject will be found in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 836.

The Brain of Laura Bridgman.

Every one has read accounts of Laura Bridgman and of the marvelous results obtained by Dr. Howe in educating her. Losing her sight, hearing, and nearly all sense of smell and taste at the age of two, she remained practically without education until the age of nearly eight years, when she was placed under Dr. Howe's care. A careful record of her intellectual progress was kept for many years, and in 1878 Professor Stanley Hall made a valuable series of physiological and psychological tests upon her. She was shown to have some sense of taste, but practically none of smell. She could not hear even the loudest noise, but appreciated vibrations. Rotation made her dizzy. Her tactile sense was two or three times more acute than normal. Mentally she was eccentric, but not defective; she lacked certain data of thought, but not the ability to use what data she possessed. Her emotions were very lively, and she had a certain hysterical tendency. She died in 1889, at the age of sixty. Her brain was obtained, and has been studied by Dr. H. H. Donaldson, of Clark University (*American Journal of Psychology*, September, 1890).

Dr. Donaldson's report is a model of careful scientific work, and contains much of interest to students of anatomy. But his findings are decidedly meager and show little more than would be expected. The brain weighed about 1,200 grammes. This is considerably below the average for women, which for Anglo-Saxon and German races is about 1,275. Considering her small stature and body weight, the brain, however, was not especially small.

An examination of the lobes and convolutions showed that there was some defect in the centers for articulate language; also defect in the occipital lobes, especially the right (visual center), and in the temporal lobes, especially the tips. This last condition may have been due to her imperfect sense of smell and taste. The fissure of Sylvius was short, and the posterior corpora quadrigemina small. A careful microscopical examination might give some important information as to the central course of the optic and olfactory tracts, but this has not yet been done. There was nothing in the appearance of the brain which would ally it to low type, criminal, and insane brains.—*Medical Record*.

HABITUAL divers in salt water often have inflammation of the eyes. The exposure such diving necessitates is not beneficial.

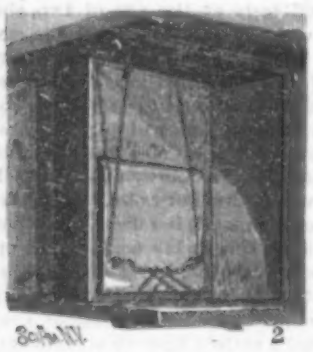
Progress of Railway Electrics.

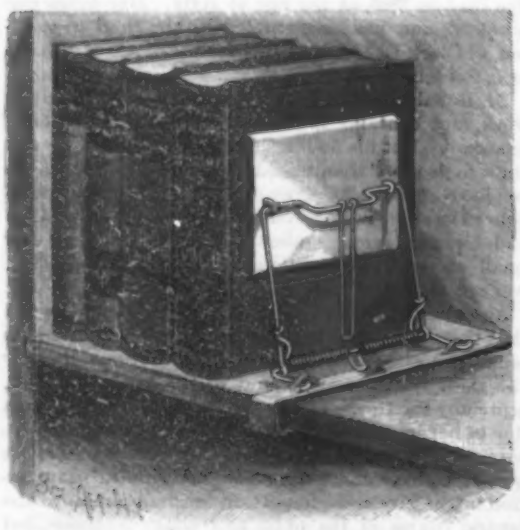
While electricity may not yet be able to take the place of steam as an economical motive power for railway trains, it is demonstrating its ability, when properly managed, of cutting into the business of existing steam railways. The latest illustration of this is to be found in the passenger travel between St. Paul and Minneapolis. Until recently the steam railroads have controlled this business, and, with the exception of the fares charged, have given a fairly satisfactory service, but an electric road is now running between the two cities, connecting with the street lines of both, and in the half year which it has so far served the public it has taken such a large portion of the patronage from the steam railways that the latter will probably withdraw from competition for the local passenger traffic between the two cities. The reason is plain. The steam railroads charged 30 cents for a single trip of ten miles and 50 cents for a round trip, while the electric road has been put on a paying basis while charging but 20 cents per round trip. In addition to this difference in fares, the electric road runs its cars more frequently and gives transfers to other street railways in either city.

The electric company is making preparations to handle a very extensive traffic, and will soon be able to run trains under one minute headway. The 30 horse power motors first used will be replaced by new ones of 50 horse power, and the cars will be run at higher speed than at first. Similar conditions of travel in other places will doubtless be met in the same way, and before railroad men realize it, electric railways will be running, the character of whose traffic will bear a very strong resemblance to that of steam railways. In this growth the fact may be developed that a comparison between steam and electricity will not always lead to the results obtained in the experiments thus far made. —*Railway Review.*

A DEVICE TO HOLD BOOKS IN ORDER.

A simple form of device, capable of attachment to any book shelf, to automatically force the books along upon the shelf to close up vacant spaces, while also permitting of the replacing of books in orderly arrangement, is shown in the accompanying illustration. It has been patented by Mr. Lewis C. Hunter, of Fort Wayne, Ind. The base of the device consists of a strip of metal bent to form a clamp adapted to engage the shelf, and on the clamp, as shown in the large view, is secured a yoke, on which is pivoted a U-shaped arm, the upper bow section of which is bent outward to form a hand hold. On the bow section of the yoke is a coiled spring, the extremities of which are attached to the U-shaped arm, while near the center of the spring the metal is bent outward to adapt it for engagement at this place with an upwardly projecting tongue of the shelf clamp. A hasp hanging on the hand hold is also adapted for engagement with this tongue when the spring is to be held under tension while a number of books are being placed in position on the shelf. At each side of the hand hold a board or plate is pivoted to the U-shaped



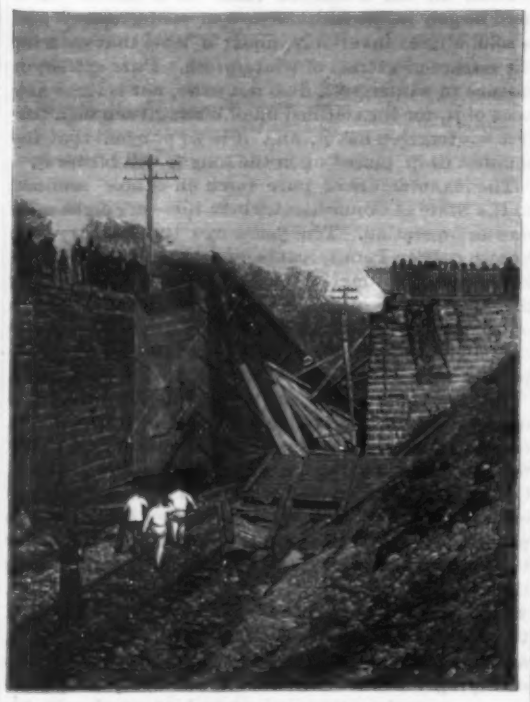


HUNTER'S BOOK SUPPORT.

arm, this board pressing against the side of the outer book, and thus causing all the books to bear snugly against one another. In Fig. 2 is shown another form of the device, wherein a perpendicular member unites an upper horizontal member with the base, and the yoke is secured to the upper member, the U-shaped arm with its plate then extending downward instead of upward, and the plate pressing against the books nearer the bottom, to more readily move them along.

A SINGULAR BRIDGE ACCIDENT.

On Sunday, April 26, while a train on the Columbia branch of the Pennsylvania Railroad was passing under a bridge on the Lancaster pike highway, at Mountville, a brake beam dropped from one of the

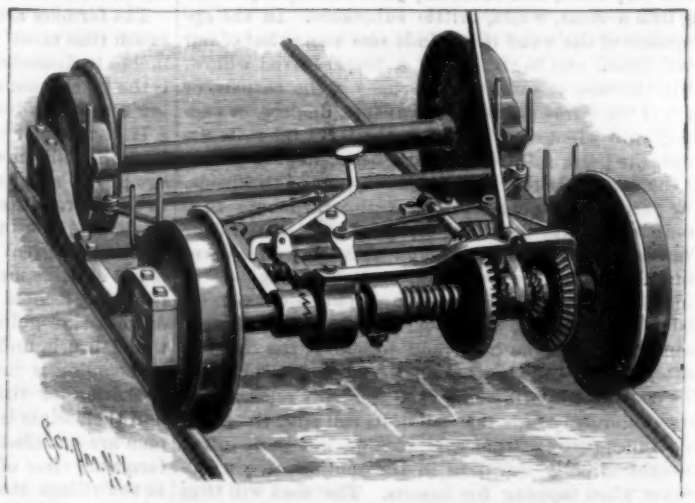


A SINGULAR BRIDGE ACCIDENT.

cars, which resulted in a wreck. Two of the cars were forced together endwise, and reared up against the under side of the bridge, lifting it off its abutments. The bridge then fell upon the railway track and broke into splinters. The bridge was 25 years old, of wood, of the Howe truss style. Distance from rail to under side of the bridge about 22 feet. Fortunately no person was on the bridge at the time of the accident. We are indebted to Mr. C. T. Emons, an amateur photographer of Columbia, Pa., for the excellent photograph from which our engraving was made.

AN AUTOMATIC CAR BRAKE.

The accompanying illustration represents the application on a car truck of a mechanism designed to be thrown into gear by the backward or forward motion of the car to automatically apply the brakes, holding them at any desired degree of tension, while they may be instantly released before starting the car. The device has been patented by Mr. William S. Fraser, of No. 4 Eighth Street, Pittsburg, Pa. The brake shoes are connected by rods with a lever centrally pivoted on a cross bar between the two axles, the lever being actuated by a screw and burr, the screw being hollow and turning loosely on one of the axles. At the opposite end of the screw is a clutch adapted to be engaged by a clutch on the axle, the latter clutch being actuated by a vertical lever extending up through the car platform, the operation of the lever setting the screw in motion to draw the burr along it, thus applying the brakes. When the car has stopped, or the brakes are applied with sufficient force, the clutch is disengaged from the screw, which then holds the brakes in position. In a drum on the cylindrical end of the screw is a coiled spring which is wound up as the screw is revolved, the spring being then held under tension by a clutch adapted to be released by a foot lever projecting through the floor of the car platform. To apply the brakes when the car is moving backward, the upright lever is moved so that the clutch actuated thereby engages a clutch on an outer bevel wheel, turning loosely on the axle, and geared with two other bevel wheels to the screw, whereby the latter will be turned in the same direction as when the car has a forward motion. When the clutch actuated by the foot lever is held off while the brakes are applied, the spring within the drum immediately throws off the brakes on the release of the clutch actuated by the lever extending above the platform.



FRASER'S AUTOMATIC CAR BRAKE.

The Sierra Madre Expedition.

News has been received from the scientific expedition which Dr. Carl Lumholtz is now conducting in the wilds of the Sierra Madre and Northern Mexico.

The expedition started from Bisbee, Arizona, in the early part of September, and entering Mexico, traveled southward through the State of Sonora, with the intention of crossing the Sierra in the direction of Yanos and Casas Grandes. Before entering the mountain region, however, the explorers separated for a time, and while Dr. Lumholtz, with the main body, pursued his intended route, a detachment under Dr. Libbey, of Princeton, made an excursion in a more westerly direction, covering some 300 miles of territory. From Granados the ascent began, and continued steadily until, on December 2, the western slopes of the Sierra Madre were reached at Nacory, when a northeasterly direction was taken.

Three mountain ranges had to be scaled, the highest some 9,000 feet in height, and the magnificence of the scenery made a strong impression upon the minds of the travelers, who took hundreds of photographs. The weather was very cold. There was snow on the mountain tops, and men and beasts suffered severely in many ways. One man, a guide, whose health was already impaired, succumbed under the strain, and his death was a serious loss to the explorers, as he knew of ruined pueblos to which he had pledged himself to lead them. Several beasts also perished. After a month of severe exertion the party reached the eastern slope of the Sierra, near Pacheco, and there took a well-earned rest.

The journey had proved a most interesting one from a scientific standpoint. Many specimens of birds and plants were collected, as well as some important fossils.

Cave and cliff dwellings were also met with, some of these in perfect condition and showing signs of having been inhabited by men who had reached a comparatively high stage of culture. In one stairs were found. In the largest of these caves remains of a whole village were discovered, and in front of it stood a huge "olla" (*i. e.*, Mexican water jar), made of clay mixed with straw and very solid, the pottery being eight inches thick. This olla was twelve feet in height and twelve feet in diameter, and when first caught sight of, presented the appearance of a huge balloon. In one of the cliff dwellings were found some human remains —a complete skeleton, which had undergone some process of mummification.

The plateau on which the party was encamped when last heard from is near Pacheco, a few days' march from Casas Grandes. The neighboring country is dotted over with many large mounds, some of which it was the intention of Dr. Lumholtz to open. Altogether, the expedition promises well, and there is no doubt that Dr. Lumholtz will bring back much valuable information and make many important additions to our knowledge of the archæology and the natural history of Northern Mexico, past and present.—*American Naturalist.*

Athletics in New York.

There are several highly popular and successful clubs in New York City, the aim of which is to promote all forms of healthful sports and exercises. One of these corporations, the Manhattan Athletic Club, has lately erected a magnificent building on Madison Avenue, at a cost of nearly one million dollars. It is furnished with a theater, gymnastic apparatus, swimming and other baths, running course and all kinds of paraphernalia calculated to delight the athlete and encourage muscular development. The membership is limited to 3,000. In addition to its grand city building, the club owns an island on Long Island Sound, near the city, used for sporting purposes, and another island on the New England coast, where members may hunt and fish.

Foreign, National, State, and County Indebtedness.

The total and per capita indebtedness of foreign nations, the United States, the several States, and their respective counties, presented in a condensed form, is given in a recent Census Bulletin, prepared by Mr. J. K. Upton, special agent of the Census office.

The indebtedness of the world for 1890 and 1880, as far as it has been possible to collect the data for the present bulletin, with the amount of increase or decrease, is as follows:

	Debt less sinking fund.	
	1890.	1880.
Total debts	$36,917,096,680	$25,818,521,219
Foreign nations	25,636,075,840	23,481,572,185
The United States	915,962,112	1,922,517,304
States and Territories	223,107,883	290,326,643
Counties	141,950,845	124,105,027

From the summary published it will be seen that relatively the burden of debt falls far heavier upon the inhabitants of the principal foreign countries, except those of Germany, than upon those of this country. France in 1889 had a debt per capita of $116.35, and it is understood that this does not include certain annuities of an unstated but large amount; Great Britain, though slowly decreasing its debt, had a burden at that time of $87.79 per capita; Russia, $30.79; Austria Hungary, $70.84; Italy, $76.06; Belgium, $63.10; the Netherlands, $95.56; while that of the United States was but $14.63, and of its indebtedness nearly one-half was made up of non-interest-bearing notes.

While individual fluctuations in the amounts of indebtedness of the seventy-nine foreign nations reported have been considerable during the decade, the aggregated indebtedness shows relatively but little change, especially if compared with the increase of population.

The public debt of the United States shows a gratifying decrease within the last ten years, the burden per capita having been reduced from $38.33 in 1880 to $14.63 in 1890.

The indebtedness of the States and Territories has also decreased $67,218,760 during the decade, reducing the per capita from $5.79 in 1880 to $3.56 in 1890. It should be remembered, however, that of the total decrease of State debt as reported there has been scaled by refunding in some of the Southern States about $28,500,000.

The indebtedness of the counties, though increasing somewhat within the decade, has not kept pace with the increase of population, and the per capita has been reduced from $2.47 in 1880 to $2.27 in 1890.

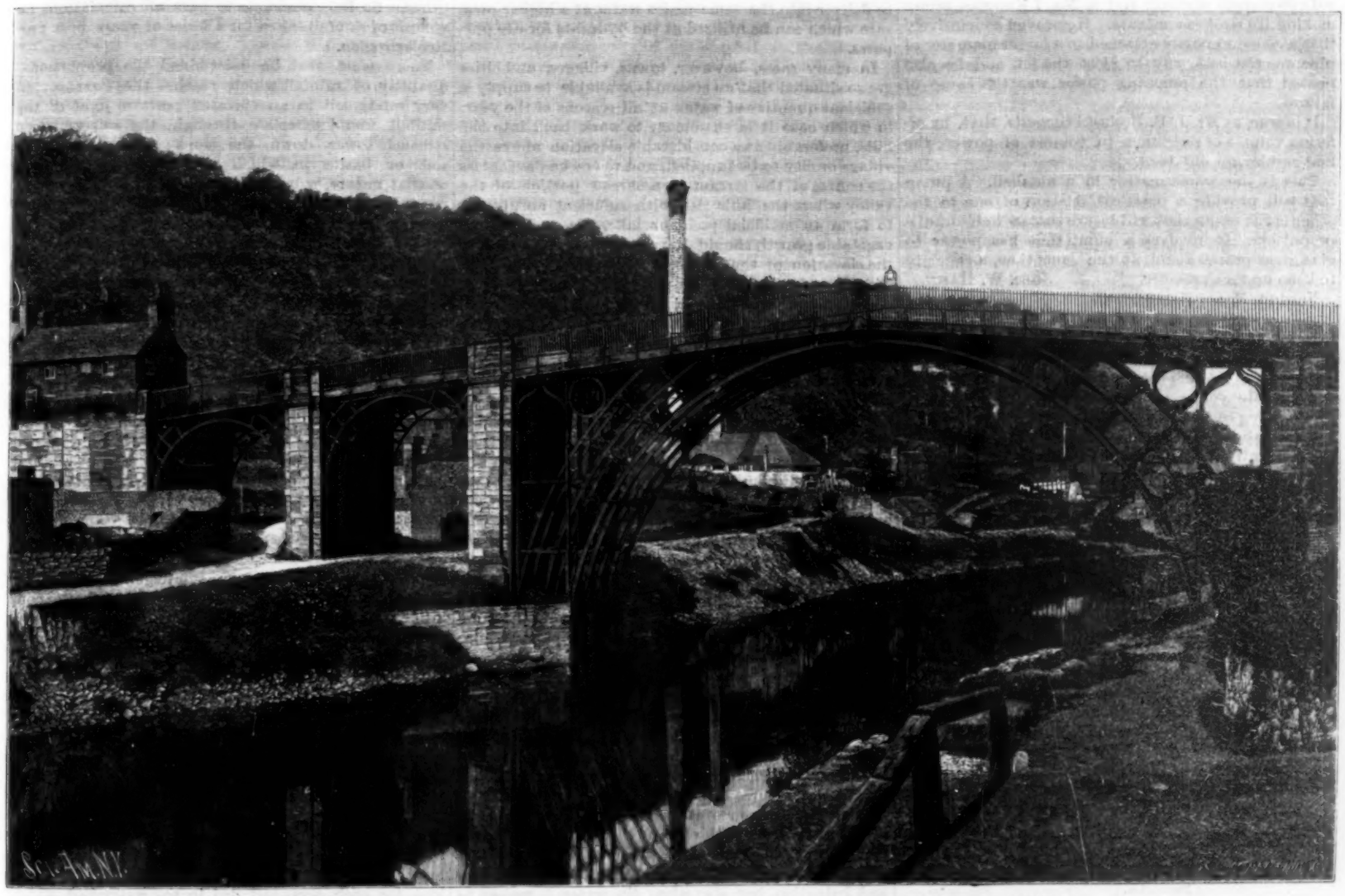
Aggregating the national, State, and county indebtedness, the per capita shows a decrease from $46.59 in 1880 to $20.46 in 1890, or more than one-half, and this decrease has been brought about mainly by voluntary taxation. The aggregate surplus receipts of another decade like the one just past would relieve the country from nearly all national, State, and county indebtedness, could they be distributed for the purpose.

COALBROOKDALE BRIDGE.

In the accompanying engraving is represented one of the most interesting bridges in England. It is located at Coalbrookdale, and is the oldest cast iron bridge in the world. It was erected by Mr. Darby, the quondam owner of the Coalbrookdale Iron Works. Owing to its novelty, it was for years considered a great curiosity, but it now owes its fame to its antiquity and to the fact that it belongs, as Mr. Andrew Carnegie said at the late meeting of the Iron and Steel Institute, to the genus of "firsts."

It was a bold experiment in a new line, and its beauty and durability still testify to the ability of its founder. It was erected in 1779. It consists of five curved ribs nearly semicircular in shape and each formed of three concentric arcs connected by radial pieces. It reaches across the Severn with a span of 100 ft., while it has a total rise of 40 ft.

It is very light and graceful in design, and has given a name to the neighboring town, which has sprung up within recent years, and is known as Ironbridge.



COALBROOKDALE BRIDGE, THE OLDEST CAST IRON BRIDGE IN THE WORLD.

The Purification of Works' Effluents and Sewage.

BY P. AND A. BUISINE.

Ferric sulphate has been very little used up to the present as an economical reagent for the purification of water by manufacturers.

The authors have succeeded in preparing the reagent from the residual burnt pyrites from chemical works, from whence there is an abundant supply at a very low figure.

By mixing the burnt pyrites with sufficient sulphuric acid of 66° B. to form a stiff paste, and keeping the mass stirred at a temperature of 100–150° C. for some hours, the pyrites become covered with a whitish coat of ferric sulphate. When the mass has again become dry, and crumbles, the acid is almost neutralized. It is then only necessary to add sufficient water, to obtain a solution of ferric sulphate of the strength desired. By working methodically, the pyrites may be completely decomposed, and converted into ferric sulphate.

The solution thus obtained constitutes an excellent reagent for the purification of the waste waters from industrial operations, and also for sewage, its cheapness rendering it available for the treatment of large volumes.

Its efficacy has been compared with that of the various reagents proposed for the chemical treatment of waters. It has moreover been tried on many very bad waters, such as the River Deule, which receives the sewage of Lille, the effluents from starch manufactories and wool scouring works, the water of the Espierre, a brook which receives the waste waters from the industrial center formed by the towns of Roubaix and Tourcoing, where so many dye and wool scouring works are located. This latter water, which is contaminated with the fatty matters resulting from the removal of the natural grease from wool, is a most difficult one to purify.

From the treatment of the water of the Espierre in particular, the following advantages, resulting from the use of ferric sulphate, have been demonstrated:

The sulphate of iron, being soluble, effects a more complete precipitation than is obtained by the addition of milk of lime. The cost of the actual process adopted for the purification of these waters, including a sufficient quantity of the reagent to effect complete precipitation, did not exceed what lime alone would cost. Again, the water purified by ferric sulphate was perfectly clear, colorless, odorless, neutral, or very slightly acid, while, where lime is employed, the water is alkaline, remains colored, possesses an unpleasant effluvium, and contains in solution a large amount of organic matter, which rapidly becomes a source of putrefactive fermentation.

The precipitate produced by sulphate of iron settles rapidly, and does not possess to such a high degree the unpleasant feature connected with lime sludge, of rapidly putrefying under the influence of heat.

Moreover, on treatment with carbon disulphide—after drying—the grease which the precipitate contains can be recovered, as the fatty matters (owing to the small quantity of free acid in the reagent) exist in the deposit in a free state.—*L'Industriel du Nord.*

Growth of the Hair after Death.

The body of E. M. Haskell, who has been dead for over twenty years, was recently removed from his grave, at Northfield, Minn., it being purposed to put the body in another lot. When his body was exposed it was found that he had a beard over twenty-three inches long. His wife said that before he died he had been shaven, and all his hair must have grown after burial.

Correspondence.

Jet Propulsion.

To the Editor of the Scientific American:

I have noticed with deep interest the discussion of hydraulic propulsion in the SCIENTIFIC AMERICAN, and I hope it will be continued until marine engineers grasp the importance of the jet propeller as a factor in the near future of marine engineering. I should like to have Mr. James S. Parmenter give further details which he has worked out, as I believe it would prove of value.

It seems to me, at the present stage of this subject, enough has been learned to determine to what the failure of jet propulsion has in the past been due. It is recognized that the principle is superior to that of the screw propeller, but the pumps employed did not produce a jet of water of sufficient power and size to make it practical for propelling steamships. The proper pump is really the vital question.

This settled, the way the jet shall impinge the water will settle itself, which I think was partly demonstrated by Mr. George G. Caldwell, in 1877. He placed a seven-eighths inch jet on each side of the rudder in a tug boat, 43 feet in length, and made 10 knots an hour with 60 pounds of steam and a No. 7 Knowles pump making 180 strokes a minute. He proved conclusively that a common nozzle attached to a larger diameter of pipe was the best way to eject the jet, and he also proved that the pumping power was the cause of failure.

It is true, as Mr. J. B. Brolaski suggests, that, by offering volume of resistance to volume of power, the best results are obtained.

This is the whole matter in a nutshell. A pump that will provide a practical relation of one to the other is the pump that will insure success to hydraulic propulsion. It involves a pump that has power to give great pressure and, at the same time, a capacity to keep up that pressure. JOHN W. HAHN.

Newton, Mass., May 30, 1891.

Pittsburg and Other Great Cities.

To the Editor of the Scientific American:

About two months before the taking of the last census, I wrote you a short article, claiming that the forthcoming census would show a population in Pittsburg of about 450,000. I was taken to task by Mr. "Conservative," who placed his estimate much below mine. The census showed that his figures were as much too low as mine were too high. Yet if Pittsburg figures took in the whole country, as New York, Philadelphia, and Chicago do, to raise their figures, my estimate would have been 100,000 under the census figures. The following extract from one of the daily papers gives a reasonable basis for figures and practically confirms my estimate:

"The Louisville *Courier-Journal* turns aside from the consideration of tariff reform and silver coinage long enough to bring its sagacity to bear upon this curious fact, and lays it down as the correct principle that the size of a city should be estimated by the area of population of which it is the core. Chicago has fattened her census exhibit by taking within the city limits a large slice of the agricultural region of Illinois, while the corporation bounds of New York are much within the real extent of the city as a center of population.

"Taking a section of country about fifty miles square about each city, their population ranks as follows:

	Population.		Population.
New York	3,621,000	Buffalo	365,000
Philadelphia	1,422,000	Minneapolis	361,000
Boston	1,334,000	San Francisco	335,000
Chicago	1,324,000	Detroit	330,000
Pittsburg	677,000	Milwaukee	330,000
St. Louis	629,000	Kansas City	300,000
Cincinnati	550,000	Albany	289,000
Baltimore	506,000	New Orleans	280,000
Providence	502,000	Louisville	277,000
Cleveland	436,000		

"See what a bound toward head Pittsburg makes on this basis of computation, sizing up alongside of Chicago and ahead of St. Louis, Cincinnati, Baltimore and other places which consider themselves rather large towns. The justice of this way of putting the case is further confirmed by the fact that it tallies pretty well with the showing made by the clearing house returns."

JOHN T. FINDLEY.

Pittsburg, May 27, 1891.

The Adjustment of Damages Arising from a Diversion of Water.*

There is no one feature more essential to the health, growth, and prosperity of a municipality than an ample supply of pure water. When a city is situated on or within a comparatively short distance of a stream of fresh water from such a source that it flows throughout the entire year through a region in which it is not liable to contamination other than a temporary discoloration by earthy matter washed into it during storms, it is customary to lift such portion of the water as is required from the bed of the stream to a distributing reservoir by means of pumps operated either by water power or steam pumping engines. In some cases a stream is available at a sufficient elevation above the city to enable the water to be conducted by gravity through an aqueduct or pipes to a distributing reservoir at a sufficient elevation above the city to enable the distribution to be effected by gravity over the greater portion thereof, when water for the higher portions is supplied by a subsidiary pumping station which lifts a smaller quantity of water either into a small reservoir at a higher elevation or into a water tower or stand pipe directly supplying water to the higher district. In some cases pumps receiving water directly from the bed of a stream or from a low service reservoir are operated to simply maintain a pressure in the whole or part of the distributing pipes of a city, and the speed of such pumps regulated merely to supply the demand. Frequently the distributing reservoirs are at such a height that the water is delivered to the mains under considerable pressure and can be utilized directly from the hydrants for the extinguishment of fires. In the direct pumping systems referred to, comparatively small pumps are generally kept in motion to supply the regular demand and larger pumps started (when notice is given by an electric or other signal) to deliver into the same mains water at a higher pressure which can be utilized at the hydrants for fire purposes.

In many cases, however, towns, villages, and cities are so situated that no stream is available to supply a sufficient quantity of water at all seasons of the year, in which case it is customary to work back into the hills, preferably at a considerable elevation above the village or city to be supplied, and to erect a dam across the course of the stream in a narrow portion of the valley where the hills rise with sufficient abruptness to form an artificial pond or lake. In such case all vegetable growth should be removed from the soil to the elevation of the proposed water level. The pond will fill up during the heavy rains in the fall and spring, and although the stream supplying the same be a small one, the water stored in the pond will be sufficient to supply deficiencies during the droughts in the summer, when there is little rain, and in the winter when the rainfall is congealed and temporarily remains as snow and ice on the hillsides. These various operations affect in different ways, according to location, the rights of the owners of the soil. If water be abstracted from a stream to supply a village or city, necessarily the amount flowing in the stream, below the dam or other point where the water is taken, is less in quantity than before and the diversion may cause injury to riparian owners by reducing the quantity of water available for water power or other manufacturing purposes, or in extreme cases that required for the proper irrigation or regular watering of the land. In very extreme cases the navigation of rivers or certain reaches in the same may be affected. It is well settled that a riparian owner is entitled to the proper use of the water as it passes his own land, and he may even divert it upon his own property so long as he returns it to the stream upon his own land, and this, evidently, may include the use of water for irrigation where the drainage returns the water to the stream. The rule brought from the Old World and established by the decisions of all countries is: "A watercourse begins *ex jure naturæ*, and having taken a certain course cannot (lawfully) be diverted." While not exactly in the line of the present discussion, it may be added that this principle applies not only when the water is usefully applied, as for water power and irrigation, but also when the water is useless, as in case of drainage. It is an established principle that "no man can divert water upon a neighbor's land," and "no change can be made in respect to surface water to the injury of any other owner." The difference in the two cases will be observed. In the first case the property owner, who wishes to utilize the water, would complain, and in the second case other parties would complain who do not wish to have the surplus water from undesirable swamps and low lands discharged upon their property. It will be seen, however, that if a natural watercourse has ever been established for the drainage of a swamp or low lands the first principle comes into play for the benefit of the owner of such low lands, for the reason that he has a right to discharge the water into the natural stream. There are also legal provisions by which low lands with no natural outlet can be drained across the lands of others in regular channels initiated and maintained under the provisions of law, and here it may be stated again collaterally that the principles of drainage are somewhat modified in large cities, where the health of all is of paramount importance, and in which, therefore, watercourses are frequently closed and the streams diverted and low lands drained under the provisions of law.

At this time we have to deal only with the question of obtaining a pure supply of water for municipal purposes. In designing a system of water supply, the first problem is to find a proper source. Even though pure streams may be near at hand at a low level, it is better first to examine all available sources at such an elevation that the distribution may be made by gravity. Natural lakes or ponds will frequently be available within five to ten miles of the place where the water is to be used, and if not, particularly if the stream is small, an artificial pond, as previously referred to, must be provided. When a desirable site is found, the first question is to ascertain whether sufficient water can be obtained at that point for the purposes required. All the water available is derived primarily from rainfall, which varies in different localities and in different years in this latitude from say 30 to 70 inches per year. An inch of water in this sense means that sufficient rain falls to cover, to a depth of one inch, the horizontal projected surface of the land, that is not the actual surface of the hillsides, but the sum of the horizontal components of all the inclined surfaces, or the area of an imaginary lake with its surface above the tops of the hills. Ordinarily the total quantity of rainfall in a year would cover this projected surface to a depth of 40 to 45 inches in this latitude, but even at the same place the quantity of water would vary greatly in different years, and this possible deficiency must be considered in connection with the size of the pond or reservoir which it is proposed to build. The quantity of rainfall will also vary greatly in different localities comparatively near each other, those on one side of a hill or mountain having more rainfall than those on the other. So it is desirable to base all calculations on records of rainfall taken for a series of years in a particular region.

There must next be determined the proportional quantity of rainfall which reaches the streams. In very sandy soil in an elevated position most of the rainfall would percolate through the soil and feed streams lower down the slope; whereas in clay soil, or basins in which part of the strata were of that nature, a larger portion of the water would reach the elevated streams. The quantity would, however, in either case, be very much dependent upon the kind and quantity of vegetation. A very large quantity of water is evaporated from the foliage of the ferns and luxuriant bushes which grow in swampy land. The evaporation from short growths of grass and weeds is greater than from tall trees. In addition to this there is always a considerable quantity of water evaporated from moist earth and quite a large quantity from all water surfaces exposed to the atmosphere. This is particularly the case where the air is dry, as it is in most inland locations. The quantity of water reaching the streams at a given elevation can only be determined accurately by actually measuring the rainfall and gauging the streams throughout the year for a number of years. This is, however, rarely practicable. It is generally necessary to estimate the flow. Gauging can, however, be made of the summer flow and of the average flow as nearly as can be judged by conference with the residents of the vicinity. It is in general necessary, however, to estimate the flow on a basis of similar conditions, which requires a study of waterworks reports and other information available in similar localities. It can frequently be assumed that 25 per cent of the rainfall reaches the streams during the summer months, from 50 to 60 per cent during a portion of the remaining period, and as high as 80 to 90 per cent when the ground is frozen, so that it will sometimes be safe to assume that one-half the rainfall reaches the streams on the average through the year. It will rarely be proper, however, to assume that so much can be utilized. This depends largely upon the amount of storage available.

One inch of rainfall corresponds to 27,152 gallons per acre, and if the average rainfall be 40 inches, a little less than one-half of this will furnish half a million gallons for each acre included in the watershed, which should in all cases be measured approximately by tracing out the height of land on a county map, or from actual survey, or something of that kind. On this basis one square mile, or 640 acres, would furnish 320,000,000 of gallons per year, or less than one million gallons per day. It may here be stated that under very favorable conditions with large storage reservoirs an average supply of 1,000,000 gallons per day throughout the year has been obtained from one square mile, but this was on a stream used for power purposes and in which the flow was frequently much less than that rate in the summer season. This example shows that such a quantity can rarely be depended upon for municipal purposes, though more than two-thirds of a million can generally be secured where the storage capacity is ample.

In calculating the proper size of storage reservoirs, the relative winter and summer flow must be considered separately, much in the same way as above described, and it must be remembered that there is an evaporation in this latitude of about 25 inches per year from the surfaces of ponds and lakes, which in effect decreases the amount of water actually available from a particular watershed. This evaporation represents an enormous quantity of water, but fortunately the loss applies only to that portion of the watershed represented by the area of the pond or lake and that of the streams entering the same.

THE maximum safe velocity of cast iron fly wheels should not exceed a rim speed of 80 feet per second.

* Chas. E. Emery, Ph.D., in the *Orank*, a publication issued the 15th of each month by the students of Sibley College.

THE EDISON ELECTRIC ILLUMINATING CO.'S CENTRAL STATION IN BROOKLYN, N. Y.

The Edison Electric Illuminating Company, of Brooklyn, N. Y., have erected and put in operation an electric lighting station which in all its appointments ranks with the most advanced works of the kind in existence. The steam plant includes a perfect system for obtaining as well as for watching and recording results. The consumption of coal is brought down to a low figure, and perfected apparatus is provided for ascertaining exactly what coal is burned. Thus a statement as to the pounds of coal consumed per electrical or mechanical horse power is entitled to the fullest confidence as being based on accurate weighing of every pound of coal consumed and of every pound of ashes left.

The station is situated at 358-362 Pearl Street, Brooklyn, N. Y. It is 75 ft. front and 100 ft. deep. At present it contains fourteen No. 32 dynamos, driven by four 300 and three 250 horse power Ball compound engines. The 250 horse power engines have one 12 in. and one 16 in. cylinder, with 22 in. stroke. The 300 horse power engines have one 13 in. and one 16 in. cylinder, with 25 in. stroke. They run at the rate of about 220 revolutions per minute. The steam is supplied by eight Babcock & Wilcox tubular boilers. The following is the general system of operating the steam plant:

The coal is received and weighed, and is elevated to the floor above the boilers. Thence it is distributed to the chutes, which in the illustration are seen leading down in front of each boiler. The chutes are provided with a valve at the bottom, and are carried by scale levers, and connected with a scale beam. The chute is filled with coal, the bottom valve being shut. It is then weighed. In the illustration the scale beams can be seen near the right hand range of chutes. The weight of the chute is allowed for, so that one weighing gives directly the weight of coal. The valve is then opened, and the coal falls down upon the floor, and is used as required for the boiler. When more coal is needed, a chute full is again weighed and delivered. The ashes, as removed from the ash pan, are carefully preserved and weighed before being sent away. This keeps an accurate watch upon the quality of the coal, and gives the basis for actual efficiency per pound of real combustible matter consumed. The consumption of coal is 2·75 lb. per indicated horse power and 3 lb. per electrical horse power. Indicator diagrams are frequently taken.

The engine and boiler rooms occupy the lower floor of the building. There are foundations for twelve engines, although only seven are now in use. The engines are belted upward directly to the dynamos, which occupy the floor above them. Sufficient inclination is given to the belting to enable it to grip the wheels well. As the dynamos are grouped in a double row over each set of engines, the belting runs alternately with opposite inclinations, as shown in the cut.

The dynamos are self-exciting and shunt-wound, and are built for an output of 575 amperes at 140 volts, but in practice are run at 650 amperes at 128 volts. Each one thus represents an output of about 112 electrical horse power and can supply 1,500 lights, representing a total of 21,000 lights in operation. An allowance of fifty per cent of idle burners is made in rating, establishing the capacity of the works to a 40,000 light district. Each lamp is of 16 candle power, is run at 114 volts potential difference with a current of 0·44 ampere nearly. If the amperes of current delivered by a dynamo are divided by the amperes required by a single lamp, the lamp capacity of the dynamo will be given. Thus, if 650 is divided by 0·44, the quotient, nearly 1,500, gives the lamp capacity of the dynamo.

The Edison three-wire system as used in these works and in the district groups the dynamos in sets of two, with three wires leading therefrom. One wire runs from the positive pole of one dynamo, another from the negative pole of the other dynamo. The other poles of the dynamos are connected so that they are in series, and from the junction the third or neutral wire runs. Thus a difference of potential of 228 volts is maintained in the system. The lamps are connected from the neutral to one or the other wire, so that in a sense the lamps are two in series. If the same number are in action on each side of the neutral line, no current goes through it. If all on one side are in action, then the same current goes through the neutral wire that goes through the active side wire. Three wires are carried everywhere throughout the district, and are so interconnected and tied at all points that an almost uniform difference of potential is maintained at all points in the region supplied.

The area thus covered with a network of distributing mains is supplied at a number of points by feeders from the station. Referring to the cut of the dynamo room, an elevated regulating gallery is seen running down its center. Along each side of this gallery heavy copper bars, called "buses," in sets of three, run. There is a "bus" for positive, for negative, and for neutral lines respectively. The main wires from the dynamos connect with these "buses," and from them the feeders are taken. The feeders are lines that run to various points in the district without any side connections. The drop in all the feeders must be uniform, and is determined by the drop in the longest. This is 13 volts when in full operation. The short feeders are calculated of such size as to give the same drop.

The dynamos, as stated, are shunt-wound. They are regulated by hand. Along the sides of the regulating gallery are German silver resistance coils, which are connected in series with the shunt. From each point of connection of the feeders pressure lines are brought back to the station and are connected to a Wheatstone bridge with galvanometer, the latter immediately over the resistance coils. By throwing more or less resistance into the shunt, the potential at the ends of the feeders is kept constant. The galvanometer reads zero when all is correct. It is adjusted from time to time by a Weston voltmeter. One or more operatives are in constant charge of the work of regulating the dynamos from the gallery.

The lamps are charged for at the rate of one cent per hour of use, and are replaced free of cost to the consumer as they fail. The well known Edison meter is used to determine the amount of consumption. The meter consists of a pair of zinc plates immersed in a solution of sulphate of zinc, connected in shunt with a resistance on the main circuit, so as to receive an integral and definite portion of the current. The zinc is dissolved off one plate and deposited upon the other. A man makes the tour of the district at the proper time and removes both zinc plates and takes them to the station. There they are weighed, and the change of weight, which is loss in one and gain in the other plate, is of course exactly proportional to the ampere-hours, which by division by 0·44 gives the lamp-hours. One milligramme of zinc represents one ampere-hour. As the voltage of the system is constant, the bills are predicated entirely on ampere- or lamp-hours. The meters are found to be accurate within two per cent. By weighing both plates a check is furnished upon the operation of the meter as well as upon the weighing. Where electrical current for power is supplied, meters are also used.

To supply the more distant parts of the district without entailing too heavy a drop of potential upon the feeders, an auxiliary station has been established in the upper part of Brooklyn. This station receives its electric power from the main station and contains its own regulating gallery and system of feeders. A special set of heavy leads or transit mains communicates between the two stations.

In New York there are now five stations in active operation, representing a capacity of over a hundred thousand lights. The most recent one is the new Pearl Street station, now in process of erection. Although the building is not half completed, a four-dynamo plant, with engines and boilers, is already established in the basement. It must be noted that in the Edison system of rating stations a large margin is provided for above the stated capacity. Thus the Twenty-sixth and Thirty-ninth Street stations, of New York, while nominally of 35,000 light capacity each, can supply 25 per cent more lamps, so that each station is good for a 50,000 or even 60,000 light district. The allowance for idle lamps cannot be made as liberal now as formerly, because lamp consumption is now supplemented by consumption by power users.

Bleaching Wool with Peroxide of Hydrogen.

Prepare the bleaching bath with one gallon peroxide of hydrogen, four gallons water, and a little ammonia—just sufficient to impart an alkaline reaction to the bath. (These proportions are open to variation according to circumstances, such as the nature of the material and the degree of whiteness required, a weak bath being used for loose fabrics and where only a moderate white is required; while a strong bath such as the above is used for a good white and for piece goods.) The bath must be used in wooden or earthenware vessels, and metals should be rigorously excluded. Scour the goods in the usual way to free them from grease and dirt, then enter them into the bath and work well until they become thoroughly saturated. Next gently wring out, and pile up in a warm place for six to eight hours. The goods must not be allowed to become dry; as long as they are moist the bleaching is going on, but it ceases as soon as they get dry, in which event the goods must be re-entered into the peroxide bath. If after this treatment the goods are not sufficiently bleached, the process should be repeated.—*Textile Mercury.*

AN EASY SOLUTION.—The *Northwestern Mechanic* is responsible for the following: A man who wanted to learn what profession he would have his son enter, put him in a room with a Bible, an apple, and a dollar bill. If he found him, when he returned, reading the Bible, he would make a clergyman out of him; if eating the apple, a farmer; and if interested in the dollar bill, a banker. When he did return, he found the boy sitting on the Bible, with the dollar bill in his pocket, and the apple almost devoured. He made a politician of him.

White Acid.

"White acid" is a name used by glass etchers to designate mixtures of hydrofluoric acid with various chemicals which are used for matting the surface of glass. The discovery of white acid is due to Berzelius, who, while engaged in his investigations on the properties of glass, made the discovery that fluoride of ammonia had the property of matting or opaquing glass. Since that time it has been found that other alkaline fluorides possessed the same power, and during the last few years this has been taken advantage of on a large scale for producing ornaments on glass of the greatest beauty. It is employed, principally, for producing ornamental figures on door lights, although it is used very extensively for decorating glass ware for table use, and also for the various sorts of globes used on lamps and gas fixtures. Extremely fine effects may be obtained on mirrors, and the silvering may be placed on either the same or the opposite side from the etching.

During the last few years, etching on glass has shown itself as a formidable rival to the sand blast, the work generally being indistinguishable from that produced by the latter, except that acid is capable of producing effects of a much greater fineness and delicacy. The grinding is much more even and therefore more easily cleaned.

In Germany, where the art has been carried to a much higher point of perfection than elsewhere, a number of formulæ for matt-etching are in use. Within a short time some of these have been published in various scientific journals, but they all belong to the category of what might be called slow acids, and are very unreliable and uncertain in their action and possess very poor keeping qualities. They are made without the ammonia salt and are dependent on soda and potash for their action, take a long time to work, and are too uncertain for practical use.

There is no doubt whatever but that the white acid compounded with fluoride of ammonia is the best. In using other white acids, spots and streaks often form in the glass, and these cannot always be removed by repeating the etching. With ammonia acids, however, any streaks which may appear, either from applying the acid unevenly or from imperfections in the glass, may be removed by repeated etchings. The following recipe is one which is used by several practical glass etchers and is said to give good results. It is of German origin, and the only objection to it is that it is too complicated, which objection may also be raised to other recipes from the same source.

In a container of lead the following mixture is made:

Distilled water	500 parts.
Fluoride of ammonia (strong)	500 "
Sulphate of ammonia	50 "
Sulphuric acid	100 "

This solution is ready for use within two hours and may be tested by immersing a piece of clean glass, which should get a nice, fine matt surface after five or six minutes.

In practical experience the writer has found that a simpler method of preparing the acid than the foregoing is capable of giving good results. Besides being cheaper, it is possible to recover the materials in it, should it for any reason get out of order.

A container of sufficient size is filled one-third full of ordinary commercial hydrofluoric acid. Carbonate of ammonia is then added. About equal parts by weight may be used. When effervescence has ceased, a small slip of clean glass is immersed in the mixture and permitted to remain 6 or 8 minutes. Upon withdrawing, it is rinsed in clean water, wiped, and dried. If examination shows that it has become evenly translucent over its entire surface, the mixture is all right and may be used for regular work. If, however, it is deeply and irregularly etched, with some parts clear and some parts ground, the acid is in excess and carbonate should be added. If, on the other hand, the glass seems to be only partially affected by the acid, and, while being slightly ground all over, is transparent, too great an amount of ammonia has been used, and acid must be added.

With a little experience, it is possible to keep the balance between the alkali and the acid, so that good results can be obtained. All white acids are subject to change in their actions from day to day, but in none of the recipes the writer has used can it be so easily regulated as in the foregoing. Before trusting any important work to the action of white acid, the acid should be tested with a clean piece of glass, and by following the hints given, the acid can be corrected to give the proper action.

In preparing glass for etching, any of the ordinary resists may be used. The drawing may be either put on glass by means of a ruling pen dipped in asphaltum properly diluted; by means of a brush; or by means of the somewhat antiquated process of covering the entire plate with Brunswick black and scraping away the parts which it is desired to grind. The best method, however, is that in which tin foil is used, a description of which must be deferred to some future time. The design can also be transferred or photographed on glass if desired.

NICHOLAUS T. NILSSON.
14 Marion Pl., Chicago.

THE WORLD'S FAIR BUILDINGS AT CHICAGO.

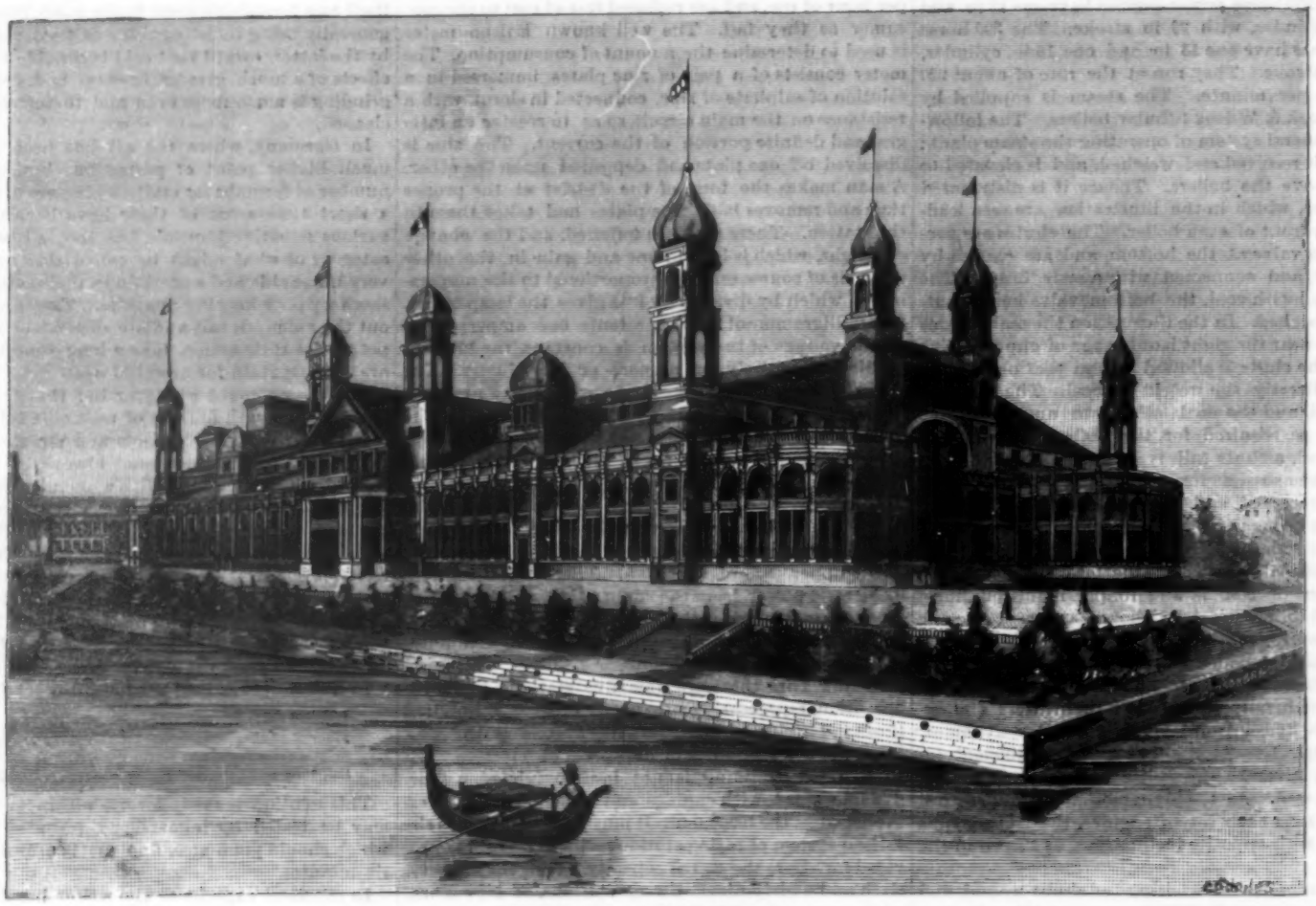
The designs for the various buildings of the Columbian World's Fair are being rapidly approved by the committee. We publish the accepted designs of the Electrical Display Building, the Fisheries Building, and the Transportation Building.

We are indebted to our enterprising contemporary the Chicago *Graphic* for the engravings.

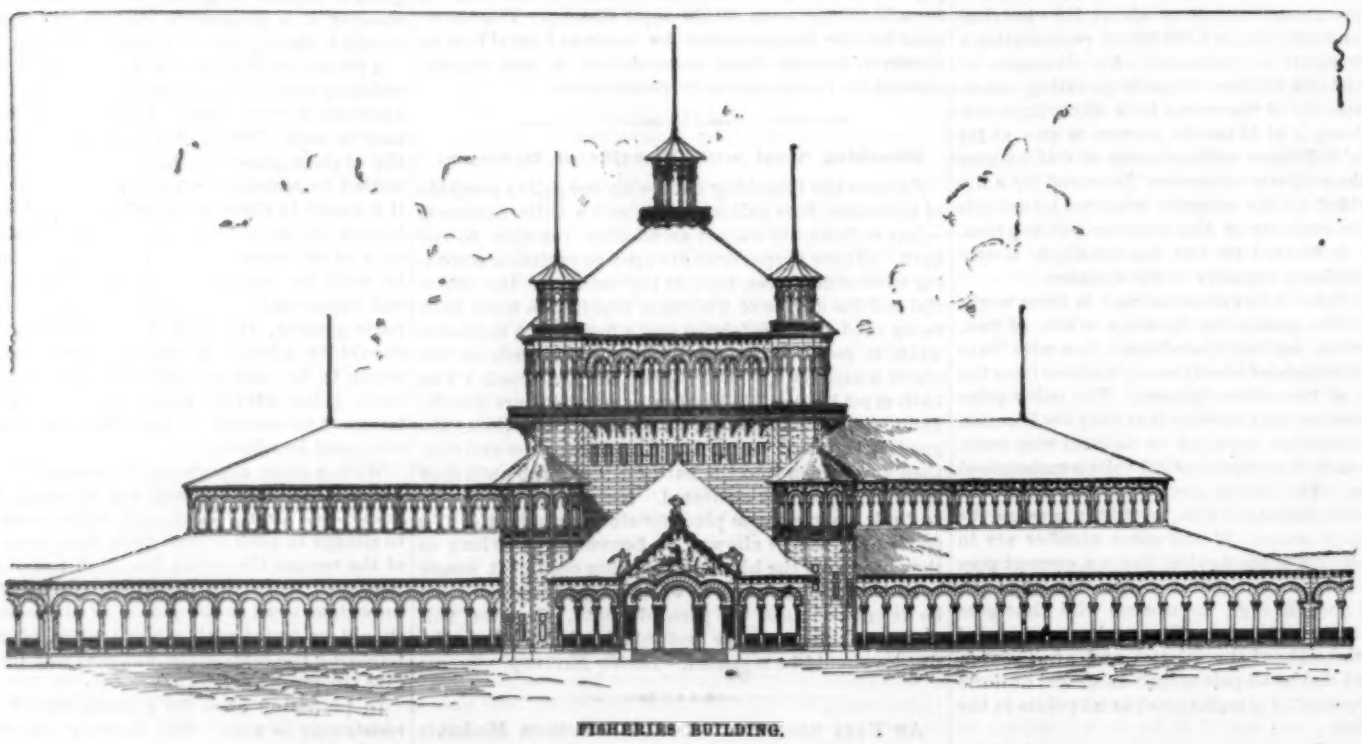
The Whitehead Torpedo.

The success of the small Chilean gun boats in sinking the large war ship of the rebels, the Blanco Encalada, by means of Whitehead torpedoes has given renewed interest in that class of missiles. At the naval exhibition now in progress in London, the latest improved specimens are shown, among them an 18 in. torpedo which, with a speed of 28½ knots for 600 yards (a rate of over 33 miles per hour), carries nearly 300 lb. of explosive. The adoption of nets projected from the side of a ship, by which the torpedoes are arrested or caused to explode harmlessly at a sufficient distance from the structure to prevent damage, makes it desirable to have net cutters. But nothing efficient has yet been produced. There is unquestionably a great field for the invention of new improvements in respect not only of torpedoes but naval appliances of all kinds. A remarkable feature about it is the bluffness of the head, showing the advance of ideas in this respect. In the nose of the torpedo is a long striker with a needle point, which causes ignition of the explosive on coming violently in contact with any hard substance, such as the bottom of a ship.

TRANSPORTATION BUILDING.



ELECTRICAL DISPLAY BUILDING.



FISHERIES BUILDING.

ACCEPTED DESIGNS OF BUILDINGS FOR THE COLUMBIAN EXPOSITION.

Ground has been broken and the work on the exhibition has been actually begun, and will be pushed with energy and vigor. The designs for some of the buildings are very beautiful, and the lagoon, the bridges, the boats, and the columns surmounted by statues of Victory and Liberty that will line the approach to the exhibition from the lake will be novel and very imposing.

A Remarkable Woman.

Mrs. Deborah Powers, head of the banking firm of D. Powers & Sons and of the great oilcloth manufacturing firm of the same name, died at her home in Lansingburg, N. Y., on May 28, at the age of 101 years. She had resided in Lansingburg for seventy-five years. She left an estate valued at two millions of dollars. She retained her mental faculties unimpaired almost to the very last.

Mrs. Powers was born in Hebron, N. H., on August 5, 1790. For eight years prior to her marriage earned her livelihood by tailoring and spinning. On February 22, 1816, she married William Powers, whom she had known from childhood, and who was a school teacher in Lansingburg.

Soon after their arrival in Lansingburg, Mr. Powers had his attention attracted by a piece of floor cloth in the bottom of a carriage, and, having some knowledge of the manufacture of table oilcloths, determined to attempt the manufacture of the article. His experiments were attended with so much success that he soon abandoned school teaching. Mrs. Powers was her husband's only assistant for some time, but the business increased so rapidly that more room and additional help were necessary. In 1829 the building of a large factory was begun.

In that year Mr. Powers was burned to death while making varnish, and Mrs. Powers was badly injured while trying to save him. Left with two small children and an unfinished factory on which a large sum was due, Mrs. Powers did not despair. She bent all her energies to the continuance of the business, with such success that in 1842 she had a fine business, a large factory free from debt, and a large sum of money. Mrs. Powers spent hours every day in the office and factory until about twenty years ago, when she surrendered the personal control of the business to her son. In 1877 Mrs. Powers organized the private bank of D. Powers & Sons, and its patronage was soon large and lucrative, everybody having confidence in Mrs. Powers' ability. It is now one of the most popular banks in that part of the State, and Henry L. Lamb, at one time superintendent of banks, is the cashier.

Grub Fungi.

We lately received from a correspondent in Bolivia a specimen of the above, also another specimen of the same character from a correspondent in Vermont. We submitted both specimens to Dr. C. V. Riley, of the Entomological Bureau at Washington, who writes us as follows concerning them:

"I have received from your office a letter from Myron E. Sprague, Plymouth Union, Vt., also a translation of a communication from Marco D. Paredes, La Paz, Bolivia, both accompanied by specimens of a fungus growing from the larva of a Lamellicorn beetle. Mr. Sprague's specimen was the common white grub fungus which I have figured and described in the *American Entomologist*, vol. iii. (June, 1880), pages 137 to 140. This fungus was formerly known by the name of *Torrubia militaris*, but is now placed in the genus *Cordyceps* and the specific name now given to it is *Ravenelii*. It infests a number of different insects. The Bolivian form is very similar; the larva is closely allied to the white grub, belonging to the same series of earth-inhabiting Scarabæids. The fungus cannot be specifically determined, as it is entirely sterile, but it is without doubt a species of *Cordyceps* and closely allied to our North American species."

Watch Glasses.

It is interesting to know something of the details and labor connected with the production of these handy adjuncts to the laboratory. The glass is blown into a sphere about a meter in diameter, sufficient metal being taken to give the required thickness, as the case may be. Disks are then cut out from this sphere with the aid of a pair of compasses having a diamond at the extremity of one leg. There is a knack in detaching the disk after it has been cut. A good workman will cut 6,000 glasses in a day.

THE TRAIN STAFF BLOCK SYSTEM.

Although single track railways are rapidly becoming a thing of the past, there are still many such roads in the country, some of which will be changed to double or quadruple track roads in obedience to the exigencies of traffic, while others will forever remain in their present condition. Some roads are furnished with a double track throughout, with the exception of a few sections or unimportant branches, which are of necessity continued on a single track system.

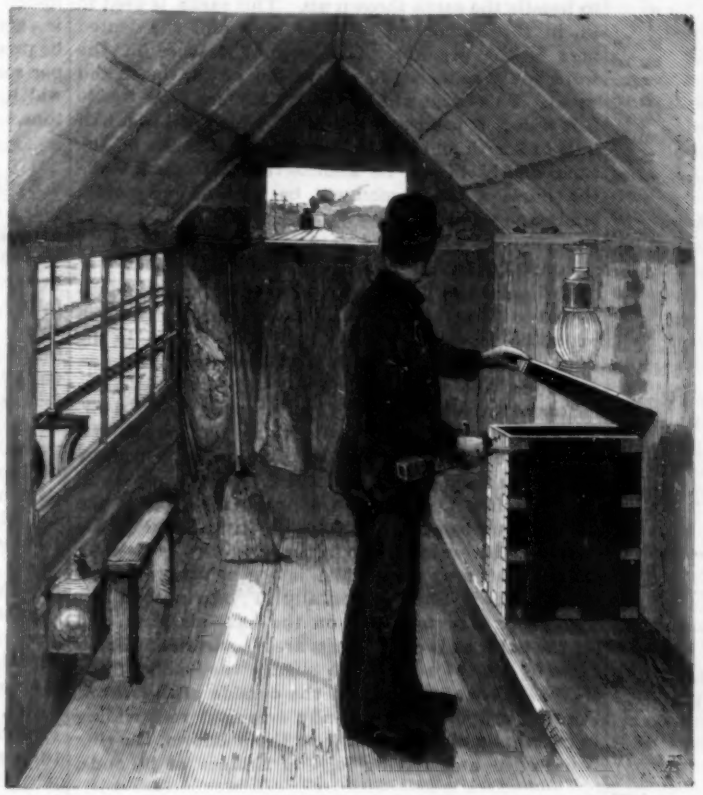


Fig. 2.—SWITCHMAN SECURING A TICKET FOR THE FIRST TRAIN OF A SERIES.

Fig. 3.—THE TRAIN STAFF.

In proportion to the traffic, more accidents occur upon single track roads and upon single track sections than upon a double track, and this is to be expected without some very perfect block system, which will prevent the entrance upon a given section of trains from opposite directions, and also limit and control the number and movements of trains passing in either direction. This has been accomplished in various ways by means of electrical devices, mechanically operated semaphores, etc., but a simpler and more effective system is in use upon the Shore Line Division of the New York, New Haven and Hartford Railroad, where the train runs over several miles of single track. The system is as simple as it is effective. It was brought from Europe some time ago by Mr. Charles P. Clark, president of the road, and it has been in successful operation ever since. For our information we are indebted to Mr. Wm. A. Waterbury, superintendent.

At each end of the single track section, in the house of the switchman, is placed a box containing tickets, which are red at one end of the section and white at the opposite end. The box is provided with a lock which can be opened only by a key carried in the end of a staff upon which is mounted a plate bearing the words "Niantic and New London." The key is movably mounted in the staff so that it may be slid out for use, or drawn in for protection. Only one staff is furnished for the section.

The mode of operation is as follows: The engineer of a train approaching the single track section—provided he is not followed by another train—upon entering the red ticket end of the section takes from the switchman the train staff, and retains it until he reaches the end of the section, when he delivers it up to the switchman at the opposite or white ticket end. So long as the staff is retained by the switchman no train can follow the out-going train, as the switchman who gave up the train staff has no means of opening the box, and cannot, therefore, authorize a train to follow the first train, either by giving a ticket to the engineer, or handing him the staff. If, however, other trains are to follow the first one entering the single track section from the same direction, the switchman gives to the engineer of the first train a red train staff ticket from the box in the switch house; at the same time he shows the engineer the train staff, thus indicating his authority to dispatch the train and to send the second train upon its arrival. If but two trains are to pass over the section in the same direction, the switchman gives to the engineer of the second train the train staff, and it is carried to the opposite end of the section and there delivered to the switchman, as in the first case. A red ticket will allow a train to pass in one direction only, a white ticket being required to allow a train to pass in the opposite direction.

It will thus be seen that until the train staff reaches the switchman at the white ticket end of the section he cannot admit a train to the section from that end without giving the engineer a white train staff ticket, or the staff itself, a thing which he cannot do until he receives the staff by the hand of the engineer from the red ticket end of the section.

Two trains moving in opposite directions cannot occupy the same section at the same time where this system is rigidly carried out. In this case the engineers and the switchmen are made directly responsible for the safe passage of the trains.

This system has been long in use in Europe on short lines, bridges, etc. It was used on the Tay bridge, and has been quite extensively adopted in Australia.

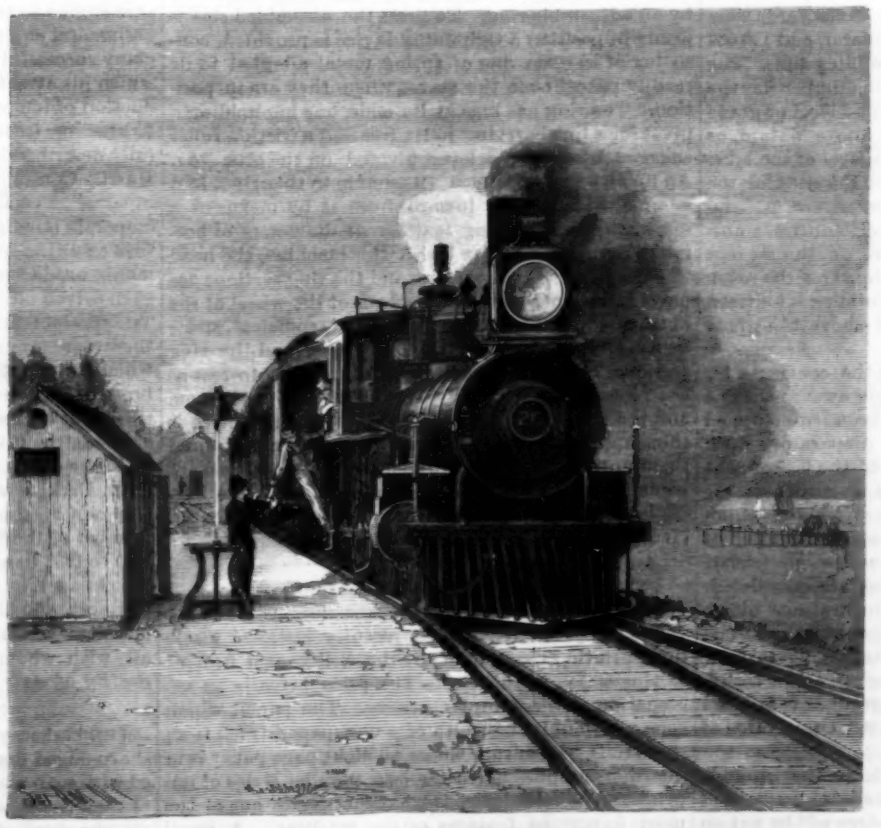


Fig. 1.—OPERATOR RECEIVING THE TRAIN STAFF.

Poisonous Dry Goods.

The British consul at Christiania, in Norway, about four months ago forwarded a letter calling the attention of the Foreign Office to the fact that, owing to the English printed fabrics containing arsenic, there had been a great decline in the quantity of such goods imported into Norway, and the British printed cloths were getting a bad reputation in consequence of their containing such a large excess of arsenic. This letter was forwarded to the Manchester Chamber of Commerce, which procured samples of the goods in question, and they were handed over to Mr. Ivan Levinstein, who had the samples examined, and they were found to contain arsenic in large quantities.

Financial Outlook for Our World's Fair.

The appropriations thus far made by sixteen States, for representation at the Columbian World's Fair, in Chicago, compare as follows with the amounts appropriated by the same States for the Centennial Exposition of 1876:

	1876.	1893.
Arizona	$5,000	$20,000
Colorado	10,000	100,000
Connecticut	25,000	25,000
Indiana	5,000	75,000
Iowa	30,000	50,000
Maine	10,000	40,000
Massachusetts	50,000	75,000
Minnesota	800	50,000
Montana	5,000	50,000
New Hampshire	10,000	25,000
New Jersey	34,000	30,000
Ohio	45,500	100,000
West Virginia	20,000	40,000
Wisconsin	22,000	65,000
Pennsylvania	1,135,000	800,000
Illinois	10,000	1,000,000
Total	$1,380,300	$2,045,000

In Arkansas, Kansas, New York, Oregon and Rhode Island, appropriation bills have failed; in Delaware, Kentucky, Maryland, Michigan, Mississippi and Nevada, the legislatures have either not assembled, or action is pending. These States made appropriations as follows for the Centennial:

Arkansas	$15,000	Mississippi	$5,000
Delaware	2,000	Nevada	20,000
Kansas	10,000	New York	33,000
Kentucky	5,000	Oregon	4,000
Maryland	15,000	Rhode Island	7,500
Michigan	7,500		

The following States, which did not appropriate a dollar for the Centennial, have made large donations to the world's Columbian Exposition:

California	$300,000	North Carolina	$25,000
Idaho	20,000	North Dakota	25,000
Missouri	150,000	Vermont	5,000
Nebraska	50,000	Washington	100,000
New Mexico	25,000	Wyoming	30,000

In 1876 the city of Philadelphia gave $1,500,000; Chicago has already voted $5,000,000. The United States spent $649,250 and loaned $1,500,000 to the Centennial Fair, which was afterward repaid. The government has voted to expend $1,500,000 on its exhibit at Chicago in 1893.

These figures show a total "in sight" thus far for Chicago of $9,275,000, against the entire amount of $5,166,750 contributed for the Centennial. Of the latter, the managers were responsible for the return of $1,500,000 to the general government, while it is safe to assume that some pretty liberal appropriations will yet be made for the Chicago Fair by the several States in which favorable action has not yet been taken.

Much Work Already Done at Chicago.

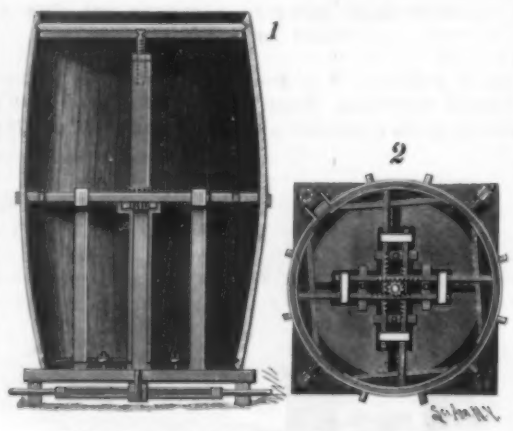
Work on the site selected for the Columbian Exposition at Chicago was begun about the middle of last February, and has proceeded in three stages—clearing the grounds of timber, collecting the black earth, and then filling in the areas from which the work was taken. About seventy acres covered with oak trees were cut away from ground five to twelve feet above the lake level. Then the black earth of the tract was collected and spread. Forty thousand cubic yards were put on the site of the natural island; 45,000 yards were deposited immediately around the island, and 120,000 yards on the territory south of the building sites. The first work done after the clearing of the timber was the filling of the building sites. The ground level or grade of the grounds is four and a half feet above datum, or about five and a half feet above the level of the lake. On the four and a half foot grade are the sites for the liberal arts, fisheries, government, agriculture, machinery, and electricity buildings. The horticulture, transportation, and woman's buildings are on the six foot level, the machinery and mines buildings on the seven foot level, while the administration building is fourteen feet above datum, or about ten feet above the grade of the grounds.

The site is practically ready and the contracts for some of the main buildings are already awarded. The 600 acres of uneven park land has been transformed into a level plain. The most of the preparatory work has been done, except the dredging of the lagoon, the canal, and the basin. The landscape gardeners are already at work, and the contractors for the buildings can begin operations. The sites for the fisheries, government, woman's, horticulture, mines, electricity, agriculture, and machinery buildings are completed. On another page will be found illustrations of accepted designs for some of the principal buildings. The sites for the administration, transportation, liberal arts, and machinery buildings are progressing satisfactorily. When the preparatory work on the grounds is finished there will have been handled 1,000,000 cubic yards of earth.

The force which has been at work on the grounds since April 1 consists of about 600 men, 235 teams, and four dredging boats. Two more dredges will be put on soon, and this force is considered sufficient to finish the grounds within the specified time of the contract, which expires early in July. The dredges are now cutting the lagoon which is to surround the natural island. They are operated night and day, the force of men and horses being sufficient during the day hours to handle the earth thrown up. This earth is used to fill in the unfinished building sites and the dented area of the grounds. The greatest feature of the work yet to come is the excavation of the basin and canal. This basin will be about 1,500 feet long by 350 feet wide. It intersects the canal, which will be a half mile in length and 150 feet wide. The banks of the canal and basin will be architecturally treated, while the shores of the lagoon will be natural and receive landscape treatment.

AN IMPROVED BARREL MAKING MACHINE.

A simple and durable barrel making machine, designed to set up and hold the staves in proper position while the hoops are being driven on, is shown in the illustration, Fig. 2 being a sectional plan view taken on a line just above the middle through Fig. 1. In the center of the platform, set on lugs resting on the floor, is a vertically arranged shaft having on its lower end a wheel with projecting arms adapted to be moved by the foot or hand to turn the wheel. On the upper end of the shaft is a platform to support the head of the barrel, there being a screw in the upper end of the shaft to raise or lower the upper platform as desired. On the shaft near its middle is a gear wheel in mesh with racks sliding horizontally in bearings on the upper ends of posts erected on the base platform, and on the outer ends of the racks are ring sections held in place by braces adapted to engage the inside of the staves. About opposite, on the outside of the staves, is a ring supported on radially arranged rods sliding in posts extending upward from the platform, the ring being open and having lugs or flanges at its ends,



DRAKE'S BARREL MAKING MACHINE.

connected with each other by a bolt, whereby the ring may be loosened or tightened on the staves, according to the diameter of the barrel. On the base platform is a false bottom, made in sections, adapted to be moved inward or outward according to the size of the barrel, and clamped in place, the lower inner ends of the staves resting against the periphery of the false bottom, and being held in engagement therewith by an adjustable ring. To press the assembled staves firmly in position a tightening device is provided, consisting of an open ring of spring metal adapted to be readily passed over the staves when they are in position. The ring has lugs at its ends, one lug holding a pivot for a link carrying in its free end a friction roller engaged by a curved lever pivoted on the other lug. An inner segment is also attachable to this ring, and adapted to be moved inward from it by means of a screw, to adapt the ring to different diameters of barrels. In making a barrel with this machine, the head is placed on the top platform and the ring sections are moved to proper position by means of the wheel at the bottom, operating the vertical shaft, sufficient space being allowed between the outer ring and the ring sections for the staves to be passed through, to rest at their lower ends between the rim of the false bottom and the surrounding ring. The tightening device is then applied to draw the staves together and hold them until the hoops are driven on, the other head not being in the barrel until afterward, or until the barrel is filled. The machine has been patented by Mr. Henry T. Drake, of Wadesborough, N. C.

The New York "Herald" Sextuple Printing Press.

The New York *Herald* has recently installed a sextuple printing press, built by the well-known firm of R. Hoe & Co., of this city. The press is really an aggregation of three duplex presses. The paper, which comes of double the width of a newspaper, is fed from three rolls. Each roll, where an eight page paper is in question, supplies paper for two parallel series of imprints. The feed device is what constitutes one of the most important features of the machine. A small roller with endless belt is caused to press against the periphery of the roll of paper. As the roller and belt rotate at uniform speed in a direction to deliver paper from the great roll, a uniform speed of delivery or feed is secured, whatever the diameter of the roll of paper. The papers are printed, cut apart, pasted if required, folded, counted, and delivered by the press. The speed is very high; as many as 90,000 four-page papers can be produced by it per hour. This is twenty-five copies per second. The press consumes 25⅞ miles of double width paper per hour. It weighs about fifty-eight tons.

Loftus Perkins.

By the death of Mr. Loftus Perkins, which took place on April 27 last, at Kilburn, the Society loses one who took a very active interest in its work, and was the representative of a family which has for long been closely associated with it. Mr. Perkins' grandfather, Jacob Perkins, an American by birth, who spent a large portion of his life in England, was a prolific and ingenious inventor. Jacob Perkins took out no less than 19 patents in the days previous to 1852, when each patent cost something over £200. The subjects dealt with included steam engines, marine propulsion, cooking, the artificial manufacture of ice, artillery (the steam gun), and, perhaps the most important of all, the method of engraving by pressure, by which the identical plates from which postage stamps are printed were for a long time produced. Jacob Perkins received three gold and two silver medals from the Society of Arts, of which he was a member, for his inventions. His son, Mr. Angier Mark Perkins, was also a member of the Society, and as an inventor, hardly less distinguished than his father. He developed the system of heating by high pressure water, in connection with which the firm of A. M. Perkins & Son has long been known. He also applied the same principle to the construction of fixed and portable baking ovens, which are largely used, the latter especially for commissariat purposes.

Mr. Loftus Perkins, the son of A. M. Perkins, and subject of this notice, possessed his full share of the hereditary genius of his family. His most important inventions were in connection with high pressure steam engines. To him must undoubtedly be given the credit of being the pioneer in the use of high pressure steam, and indeed the pressures which he used with perfect safety have never been attained by any other inventor. He appears to have been the first to enunciate and employ the principle of using steam at a pressure such as that of 500 lb. on the square inch, and expanding it several times, so as to obtain a very large amount of power from a very small amount of steam. One of his engines was placed in the steam yacht Anthracite, and after the engine had been made the subject of a very careful and elaborate test by Sir Frederick Bramwell, the Anthracite crossed the Atlantic to New York and returned, steaming the whole way—the very smallest steamer which has ever done this. The object of the experiment was to show, in a striking manner, the great economy of fuel obtained by the use of the Perkins engine and boiler. The high pressure engine was, however, not a commercial success, for whether from ill luck, or from whatever cause, it did not appear to work satisfactorily except in Mr. Perkins' own hands, or in the skilled hands of those trained by him. He also applied the high pressure engine to traction on common roads, and an experimental engine, constructed for the purpose, made many successful road journeys. The latest subject to which his attention was devoted was the artificial reduction of temperature for industrial purposes. The Arktos, or freezing apparatus, invented by him was fully described in the fourth lecture of Mr. H. Graham Harris' Cantor course on "Heat Engines other than Steam." The apparatus is one of the class in which ammonia is employed, a great reduction of temperature resulting from the vaporization of the liquid ammonia produced by liquefaction of the gas after it has been driven off from its solution by moderate heat. The special feature of the Perkins apparatus was that there were no moving parts in it. The incessant labor which he devoted to the perfection of this invention brought on a severe illness about a year ago, and from this he never recovered, though he had the satisfaction of seeing the invention in perfect working order before he broke down.

Mr. Perkins was born in 1834. Following the example of his grandfather and his father, he became a member of the Society, which he joined in 1877. From 1881 to 1883 he served upon the Council. Among those who know him he was regarded with feelings of the warmest affection, for his kindly nature, his genial manners, and his generous character endeared him to all with whom he came in contact.—*Journal of the Society of Arts.*

THE best way to bore rubber stoppers is to use a sharp-edged brass tube as thin as possible, and lubricated with soap and water. The hole will be a little smaller than the tube. It may be done by hand, or the tube may be chucked in a lathe. The tube is to be rotated and pressed against the stopper.

Water and Wind.

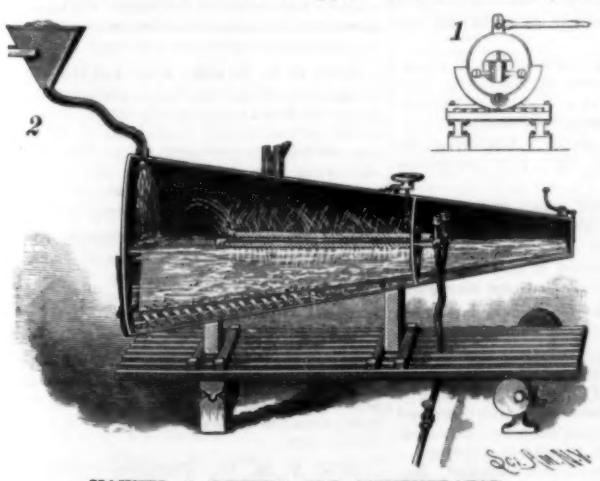
The latest news from Germany shows that a definite contract has been made for transmitting power electrically from the falls of the Lauffen to Frankfort-on-the-Main, a distance of 112 miles, for service at the electrical exhibition which is to be opened at that place on June 15. At Hartford, Conn., a similar transmission of power is successfully made for a distance of 22 miles for lighting purposes. In several places in both Europe and America, electric power is transmitted distances of five to ten miles.

At Coronada Beach, Cal., a company has invented and successfully applied an apparatus to a section of the surface of the sea, by which its ceaseless motion is converted into electric energy; and this is transmitted through a cable to the point where it is needed for the usual service of an electric current.

Thus, not only is the application of electricity rendering available a multitude of water falls in stream and tide which have hitherto been useless for mechanical purposes, but wind power on every hill top can be gathered in by the blades of the windmill, and thence conveyed to the more accessible plain. It will not be long ere fuel of all kinds may be to a large extent superseded in dwellings, and its uses performed in a better manner by the new household servant—electricity. Thus, possibly, we may be saved from the tyranny of the coal mine and the wood pile, and from their final exhaustion, by the utilization of an exhaustless power which everywhere pervades the universe.—*Practical Electricity.*

AN IMPROVED ORE CONCENTRATOR.

The illustration represents a concentrator recently patented by Messrs. Fred Manuel and Kenneth M. Reeves, of Helena, Mont., which is designed to be very effective in operation and readily separate the concentrates from the tailings. It consists of a conical cylinder mounted to rock on a series of longitudinal strips on the top of a table, which can be raised and lowered at the small end of the cylinder, where the tailings and water are discharged, the pulp being introduced through a flexible tube from a hopper near the larger end of the cylinder, as shown in Fig. 2. The two rockers, of which one is shown in transverse section in Fig. 2, have each, in the middle of their under side, a V-shaped notch engaging one of the longitudinal strips of the table, whereby the cylinder is returned to the proper place as it is rocked to the right and left, there being also transverse guide strips on the table on each side of each rocker. The table, under the small end of the cylinder, is raised or lowered by eccentrics on a transverse shaft, having on one end a belt wheel or other means of turning the shaft, or jack screws may be employed instead of the eccentrics, the table at its other end being fulcrumed on recessed supports. At one place on the top of the cylinder are brackets, as shown in Fig. 1, pivotally connected with a pitman, through which, by means of suitable machinery, the cylinder is rocked on the strips, giving a continued series of jarring motions designed to effectively agitate the pulp. The small end of the cylinder is opened by a gate hung on a lever under the control of the operator, and in the cylinder, near this end, is arranged a water feed pipe, connected by a flexible tube with a suitable source of supply. Segmental and

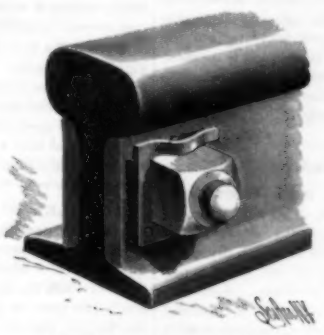


MANUEL & REEVES' ORE CONCENTRATOR.

longitudinal perforated pipes, with nozzles, extend from this water feed pipe on the inside of the cylinder, whereby the discharge of water in jets is designed to aid in the agitation of the pulp. Near the feed water pipe is a gate, adapted to be raised or lowered by a screw rod extending through the top of the cylinder, this gate being designed to retain finely pulverized ore floating on the top of the water, the lower edge of the gate being kept below the surface of the water in the cylinder. In a pocket in the bottom of the cylinder is a conveyer screw, the shaft of which has at its outer end a ratchet wheel engaged by a spring-pressed pawl fulcrumed on a lever, connected by a rod with suitable machinery for rotating the screw at intervals. The concentrates settling in the bottom are thus fed toward the large end of the cylinder, where they are discharged through a suitable opening provided therefor, the tailings and water flowing out through the gate at the small end of the cylinder.

A SIMPLE AND EFFECTIVE NUT LOCK.

In the device shown herewith, which has been patented by Mr. Samuel M. Churchill, of Lawtey, Fla., the lock is established by means of a washer having a spring tongue transversely of its face, by which the lock is formed. The washer is of a double thickness, being formed of two metal plates riveted together on one side, or, when applied to a wood surface, secured by a screw arranged to enter the wood. The plates



CHURCHILL'S NUT LOCK.

are of spring steel, the outer plate extending beyond the inner one, and this extended portion being partly divided from the main portion by a slit. A spring tongue is thus formed, in which is produced a curved middle portion. As the nut is screwed on or off, its corners ride over the curved projection of the tongue, forcing the latter down, but when screwed to place, a flat side of the nut is made to come in line with the slit, allowing the spring tongue to rise and bring its curved portion up against the side of the nut. As the main portion of the spring tongue does not project above the washer, there is no necessity to hold it down in putting the nut on or off, the operation being simple and quick, and the locking device automatic in its action.

Facts about Lime and Limestone.

With regard to the burning of limestone or carbonate of lime, pure carbonate of lime may be subjected to the intense heat of the oxyhydrogen blowpipe without losing its power of slaking when exposed to moist air, a fact but too well known to all who use the lime light. Even natural limestones of considerable purity can be exposed to the highest available temperatures without deterioration of the resulting hydrate; and I have myself exposed Buxton limestone to the intense white heat of a steel furnace, and subsequently found it to slake as well as the same stone burnt in the ordinary way. Should any of the limestone be insufficiently burnt, *i. e.*, should it still retain its carbonic acid, it will not slake, and the lumps can easily be separated from that which has been converted into a fine powder by the slaking process. The use of wood for burning lime has the great advantage that it does not introduce the deleterious sulphur compounds present in all mineral fuels.

The interesting experiments of Wolters and other observers have clearly proved that the presence of carbonic acid is not necessary for the setting of mortars, and that mortars will set perfectly well in an atmosphere quite free from carbonic acid. No doubt the ultimate hardness of mortars is much increased by the gradual absorption of carbonic acid; but the process is extremely slow, and as it requires several generations for its completion, we must not rely on it for modern work. Dr. Ziureck found a considerable percentage of caustic lime in mortar 500 years old, and a sample of mortar from a bridge over the Great Western Railway, which was removed last April, and was about 50 years old, still contained 27 per cent of the lime in a caustic state. Air-slaked lime does not absorb carbonic acid unless free water is present; this has now been known for more than twenty years, and yet some persons specify that lime shall be newly slaked.

This is in direct contradiction, both to the practice of the ancients and modern scientific observation. There is a reason for the use of pulverized marble. Marble, even in the finest particles, is crystalline in structure; and it is a fact, well known to chemists, that a particle of a crystalline substance will often produce crystallization, when added to a mass of identical chemical composition, but amorphous in structure. It is, therefore, highly probable that the presence of these crystalline particles in mortar may cause the carbonate of lime, which is slowly formed, to assume the crystalline structure; and, as this is the final and most permanent form of all mineral substances, the result is, no doubt, favorable as regards the permanence of the mortar.

With regard to the admixture of glue with *whiting*, this could hardly be very desirable; but *caustic* lime would have a very different chemical action on the glue. I have used for many years for painting woodwork, out of doors, a mixture of blood and caustic lime, which mixture is much more desirable than a wash of lime or even Portland cement; and yet the blood alone is a very unstable substance.—*Walter F. Reid, F.I.C.*

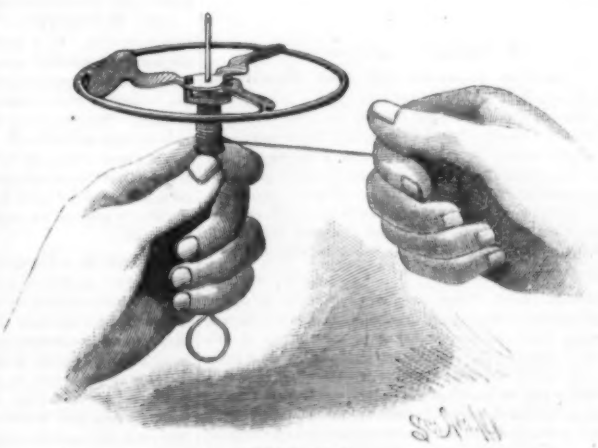
The Next Advance in Telescope Making.

Why, asks the *Pall Mall Budget*, is it so difficult and expensive to construct an immense telescope? From the time of Galileo to that of Clark, steady work has been done, and each step has given us a larger object glass. The pupil of the eye is one-fifth of an inch in diameter, and can grasp but a limited amount of light. A 25 inch object glass will enable the eye to take in over 15,000 times more light, and with such a glass the moon can be seen as though it were only 80 miles away; but if the size of the object glass could be further increased, the moon would be brought considerably nearer. To make a large object glass is the difficulty, and it is only after years of patient work of the most skilled men on earth and after repeated attempts that one can be produced which is accurate. Slight differences of specific gravity, changes of structure due to jarring, strains resulting from unequal pressure and changes of temperature, are all capable of ruining the work. Some one who is anxious to anticipate events has asked: Why not replace the glass, which is only a medium transmitting light at a different velocity from air, by a properly constructed electric field? It is conceivable that an electric field 50 feet in diameter could be arranged. Just what the nature of this field should be, with our present knowledge, we cannot say, but some day it will be known, and then the secrets of the other planets will be ours. Ether (says a technical paper) is now paramount with experimentalists; some day it will form the basis of all electrical text books. We seem to be on the verge of discovering something really great in the world of ether. The early experiments of Faraday, the marvelous mathematical researches of Maxwell, and the crowning experiments of Hertz, all show the intimate relations which exist between electricity and light. They have so entirely changed our views of science that it has been truly said that electricity has annexed the whole domain of optics.

SIMPLE AERIAL TOP.

Zip! up, up, she goes! "There! she's out of sight!" An instant of silence. "There she comes! down, down, down, there she is across the street." In the lively scramble a lucky youngster grabs it, and hastening to the vender, says, "Here she is, mister." "All right," says the vender. "I give you a penny every time you catch the aerial top."

This is a 42d Street scene: "Here is your aerial top, a regular sky skimmer. You can see it go out of sight. Only ten cents." Meanwhile, in the intervals of the jangle, the vender with his bird warbler imitated the canary, mocking bird, various animals, and Punch



AERIAL TOP.

and Judy. A new comer says, "I'd like to see it go up," and up she goes, down she comes, and another gamin gets his penny for securing the sky skimmer, while an occasional passer-by invests a dime in the interesting toy.

The object of so much interest was a simple three-armed wheel punched out of tin, with its arms widened at their outer ends and all inclined in the same direction, a little spool with prongs at one end which enter corresponding holes in the central portion of the wheel, a wire supporting the whole, and a string wound around the spool for giving the flier its impulse. The string is quickly pulled, and the rapid rotation of this aerial screw propeller causes it to leave its prime mover and fly skyward out of sight.

RECENTLY PATENTED INVENTIONS.

Engineering.

TRAM ENGINE. — Walter De Sanno, Corry, Pa. In this engine a countershaft aligns horizontally with the axles, there being a sprocket wheel connection between the shaft and the axles, while two crank shafts are journaled above the countershaft and connected with it by gear mechanism, the crank shafts being operated by a suitable engine. The construction is such as to avoid all strain on the driving chains when the wheels drop into low places on the track, and the equalizing bars which support the engine are so arranged that the weight of the engine will be equally distributed on the driving wheels regardless of the condition of the track.

GAS ENGINE.—Isaac F. Allman, New York City. This engine has a vertical water-jacketed cylinder, open at its upper end and closed at its lower end by a head which extends partly into the cylinder. In the inner end of this head is a semi-spherical recess, while the piston reciprocating in the cylinder has a corresponding semi-spherical recess, so that when the piston is in its lowermost position the two recesses form a hollow sphere. The piston is pivotally connected with a pitman, connected with the crank arm on the main driving shaft, and the valve chamber and relief valve are arranged on the outside of the cylinder, where they can be readily taken off and replaced without disturbing the cylinder and its piston.

FEED WATER HEATER AND PURIFIER. —Hamilton A. Anderson and Charles C. McClaughry, Joliet, Ill. A lateral steam pipe is attached to a vertical heating chamber, above which is a condensing chamber connected with a water supply pipe, and a device conveys water from the condenser in graduated quantity to the water-heating chamber, while a series of oppositely inclined plates is arranged in series vertically on which the inducted water may flow and be heated by enveloping steam. It is designed that the calcareous matter and earthy impurities will thus be liberated from the hot water and deposited in grains or scales upon the plates, to be washed off by the flow of water into the lower part of the chamber, from which the eliminated impurities are discharged, the water passed to the boiler being heated nearly to the boiling point.

VALVE OPERATING GEAR. — Carl Gramm, Berlin, Germany. This invention relates to gas, petroleum, or other similar engines, providing therefor two adjacent closing devices, such as distributing or slide valves, which may be alternately operated, so that when one of the devices is opened the other will be closed, and vice versa. The valve-operating gear consists of a horizontally reciprocable block on which is a gravitating vertically rocking bell crank lever, there being a yielding trip or catch for the lever and a connection between the reciprocable block and the way shaft of the engine.

Railway Appliances.

ADJUSTABLE CAR STRAP.—Benjamin P. Johnson, New York City. This strap has its upper end secured to the longitudinal rod below the car roof and its opposite end formed into a loop, with a hook and eye for securing the loop to the body of the strap, the loop being adapted to engage a keeper, by which the strap may be looped up to suit the height of a tall person, the strap being readily adjustable to suit people of various heights.

TROLLEY FOR ELECTRIC RAILWAY.—John Sullivan, Washington, D. C. This invention provides a grooved trolley wheel for an overhead electrical conductor, the wheel having a thin-edged central circular contact portion and two laterally adjacent circular toothed portions separated from the contact portion by a narrow space. The wheel is designed to break up and dislodge a covering of ice or snow with which the conducting wire may become coated, and secure at all times a perfect mechanical and electrical contact, so that the current will be uninterruptedly transmitted to the motor.

Mechanical Appliances.

TENSION REGULATOR FOR BOBBINS. —Edwin E. Biederman, Brooklyn, N. Y. This device comprises supports for the bobbin, and a rod pivoted in the rear with a handle and projecting frame carrying a weight resting on the bobbin, with a spring-pressed revoluble eccentric having a chain connecting it with the handle. The object of the device is to regulate the tension in such a manner that it will be practically the same whether the ball of twine is wound from a full bobbin or from one which has but little twine on it.

PULLEY. — John T. Carmody, Cedar Rapids, Iowa. This invention provides a pulley designed to be strong and durable, and equally balanced, while it may be constructed as a solid pulley or as a split pulley. The spokes are clamped at their inner ends on the hub and connected at their outer ends to a spider ring supporting the pulley rim, the hub being made in two ring sections, one having the bore and an exterior annular flange, opposite which is a ring adapted to be fastened by bolts or other means to the flange.

CAN SOLDERING MACHINE. — Robert Loggie and Joseph Mazroll, Black Brook, Canada. This machine has a disk mounted to turn and rotate the can, in connection with a spider turning loosely and supporting the lower end of the can, a soldering iron held in contact with molten solder engaging the seam of the can, with means for imparting a sliding movement to the disk and at the same time swinging the spider. The machine is simple and durable in construction and designed to do its work quickly and well.

DITCHING MACHINE.—William T. McNeely, Reno, Ill. This is a machine especially designed for use in railroading, for ditching cuts, widening fills, or ditching the track outside of cuts, and is also adapted for carrying filling to places where sags are to be corrected. It has a vehicle body divided into compartments, over which is a laterally movable platform connected to actuating mechanism carried by the vehicle, while horizontally aligning turrets are carried by the platform, turn tables revolving in opposite directions in the turrets, derricks being secured to the turn tables, while a bucket-elevating mechanism is carried by the turn tables and connected with derricks.

PULP DIGESTER LINING.—William O. Comstock, New York City. Combined with a cylindrical shell and circular ledges riveted or bolted thereon are non-corrosive lining rings of metal or alloy softer than the shell and ledges, each ring supported on a ledge, while a joint covering ring is secured at its edges over the ledges and upon the edge portions of adjacent lining rings. The invention is designed to provide an acid proof sectional lining, by the use of a peculiar combination of metals, and supported within the shell in a novel manner, whereby increased efficiency is secured at a moderate cost.

PAPER COATING MACHINE.—John J. Newman, Elkhart, Ind. Combined with the calender rolls and reel are coating devices arranged between the rolls and reel, in connection with vertically adjustable guides or lifting devices arranged to straighten the paper on the coating devices. The machine is inexpensive, and designed to facilitate the waterproofing, waxing or coating of paper, reducing to a minimum the danger of breaking the paper treated.

Agricultural.

HARVESTER. — J. C. and George A. Cunningham, St. Mary's, Kansas. This is an improvement on a low binding machine for which several former patents have been issued to the same inventors, the main object of the present invention being to provide for the lifting and tilting of the frame. According to the improved construction, a lever may be operated to raise or lower the frame for cutting the grain at such a distance above the ground as may be required, while, when the machine is to be moved from place to place, the frame may be raised some distance above the ground by means of another lever.

STRAW STACKER.—John Oneill, Plainview, Ill. This is an implement adapted for attachment to and to be carried by thrashing machines or separators. A frame is pivoted to swing horizontally, and a vertically swinging conveyer is pivoted in the frame, in connection with a line shaft and means for operating conveyer belts. The implement is designed to be handled generally with less labor than stackers of the ordinary construction, and may be manipulated to build a stack at one side of a fence while the implement is on the other side.

MILK STRAINER. — Iris Heimbaugh, Montrose, Iowa. This device has a funnel piece flattened on one side and with its edge recurved to afford a fit on the side of a cylindrical pail, springs being adapted to engage the ears of the pail and hold the strainer on it, while there is a screen in the funnel piece and a throat ring on it holding a strainer cloth engaged by a sliding band. The device is simple and inexpensive, and adapted to be quickly and removably attached to a milk pail, to receive and thoroughly strain the contents.

Miscellaneous.

ORDNANCE SHIELD. — Patrick McMahon, Manchester, Mich. This is a structure mounted on a wheeled frame and designed to be moved in any direction upon the field of battle, to serve as a protection to the rank and file against the attack of infantry and cavalry. A series of arms extend forwardly and vertically from the axle, and these arms support two angularly arranged deflecting plates, the lower plate terminating within a few inches of the ground, while the upper plate is of convenient height to permit soldiers in its rear to fire over it. The tongue to which the team is attached for moving the shield extends rearwardly, and rear legs rest on the ground to hold the shield in proper position. Bullets striking the face of this shield will be deflected upwardly over the heads of the soldiers behind it, or will be deflected down to the ground. The shield is also provided with spear tops as a protection from advancing cavalry.

ICE MACHINE. — Thomas J. Lemon, New York City. In a tank having a removable cover are mounted suitable moulds inclosed by a skeleton cylinder having spiral walls, there being a gear mechanism connected with a crank handle for operating the cylinder. The moulds are filled with water to be frozen, and the tank is filled with chemicals forming a freezing mixture, when, by turning the crank handle, the cylinder is revolved, agitating the chemicals and causing them to act rapidly upon the water in the moulds. The machine is adapted for making ice on a small scale for family use.

DERRICK.—Foster Milliken, New York City. This invention provides an improvement in derricks designed to hoist heavy weights, and provides means whereby the mast and boom may be of tubular shape, while its construction is such that articles may be lifted and carried from place to place within the compass of the boom, in a simple, effective and expeditious manner. After the load has been removed the hoist rope may be readily drawn to receive another load, and the ropes are protected from undue frictional contact with the guides or supports.

CURTAIN FIXTURE. — John J. Newbaker, Steelton, Pa. This invention provides, as an improved article of manufacture, a bracket-supporting bar having parallel slots formed inward from and opening out of its ends, the parallelism of the slot serving to prevent the brackets from turning, and the bar being adapted to be cut off to fit the window. The bar is also preferably provided with end clasps or plates, to embrace and slide along portions of the bar, to which they are readily adjustable.

SUSPENDERS.—Henry N. Elliott and Edwin L. Bemis, Los Angeles, Cal. A hook plate with with a hook on its upper end has also a U-shaped plate formed on its lower end, between the arms of which pass the waistband, a rivet made in two parts passing through the plates to fasten the waistband in place on the plate, while a strip forms at one end a tongue for the hook, its lower end being formed into a hook to support the drawers.

BARREL TRUNDLER.—Ira Lutes, Cairo, Ill. Pivoted to a saddle board on the upper ends of standards carried by a truck is a pair of curved crossed limbs, the outer ends of each of which carry on a stud a loosely held disk, on the inner face of which balls are held in grooves, in such manner that the barrel may be clamped thereby. The barrel may be elevated from the ground by depressing the handle ends of the limbs, and then moved in this way, or it may be rolled upon its chine, the anti-friction disks allowing this to be done with but little friction, while affording perfect control of the moving barrel.

BARREL RACK. — John B. Duncan, Fayette, Mo. This invention combines a roller truck and barrel rack with an attached adjustable barrel-tilting device. It is designed more especially to facilitate the moving, handling and placing in position of heavy barrels, such as barrels of sirup, oils, etc., that have to be left on tap. The whole rack or stand may be cheaply made, mainly of wood, and is designed to enable one man to readily handle a heavy barrel.

TRAMWAY.—John F. Vinton, Spokane Falls, Washington. This invention provides a simple and inexpensive construction by means of which ores or other material may be conveyed by gravity. It is specially designed for carrying sacked ores, etc., from mines located high in the mountains, from which inclines may be obtainable by outlets in the valleys, to streams, railroads, or refining mills.

BICYCLE SUPPORT. — Frederick G. Taylor, Cranston, R. I. This is a brace or supporting rod, of simple construction, to be attached to a bicycle on either side or wheel, to prevent the bicycle from falling over when not in use or when the rider desires to rest. The brace is provided with a sleeve fastened to the bicycle frame, preferably in a vertical position, a rod sliding in the sleeve and having a handle in convenient reach of the operator, who, by turning the handle, with or without dismounting, causes the brace to be moved down to proper supporting position.

GAME COUNTER. — Gustave Deimel, Hancock, Mich. This is a base ball game register and indicator, in which dial wheels are revolubly supported to be manually rotated in a case. The wheels each have two circular rows of figures, each row in groups, one row on each wheel showing a numeral at a sight hole in the case, indicating the number of strikes made by a player, and the other row indicating the number of players put out. It is a simple and compact device whereby the score can be readily kept and conspicuously exhibited as the game progresses.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

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(3069) Miss M. S. asks: Is there any way for women to learn mechanism? I want to invent. Have had some good ideas, but do not know how to work them out. A. One good method of acquiring a practical knowledge of mechanism would be to visit places where machinery is used, watch its operation, and then make drawings thereof. You might begin with a single cylinder steam printing press. Examine it carefully when in motion, fix the form and movements of the various parts in your mind, and at your leisure make drawings. After that try other machines in the same manner. Perseverance in this practice will let you into the secrets of mechanism, and facilitate you in working out even difficult mechanical problems.

(3070) S. S. R. asks why it is that in the so-called anti-rust tinware rust is prevented on the inside by attaching a strip of zinc to the tin. It can hardly be a galvanic action, as it has no effect on the outside when the zinc is placed inside. A. It changes the galvanic action from the iron to the zinc. The zinc is gradually eaten away. If zinc was on the outside and the article placed in water, the effect would be the same.

(3071) H. H. D.—The cheapest railway we think of is that described in SCIENTIFIC AMERICAN for December 20, 1890. The rails are of wood. Cost for 1¼ miles of track, including engine, $700. The track cost $300, and the engine $400.

(3072) C. B. D. N.—If the nails are stained apply a little lemon juice. A little pumice stone in a very fine powder or a little putty powder may be used to polish the nails. This is frequently colored with a decoction of cochineal. Apply with a piece of chamois skin.

(3073) F. M. O.—Portland cement one part, clean white sand two parts, will make a light colored mortar, for a sidewalk or other purpose.

(3074) T. H. H. asks: How can silver be extracted from an alloy of tin, silver, and a trace of copper, amalgamated with mercury? The article is waste dental amalgam, which I wish to get the silver from. A. Fuse the amalgam in a crucible with enough carbonate and nitrate of soda to keep it well covered.

(3075) G. S. M.—It would be impossible to identify with certainty the finely comminuted herbs which you send. However, after a close examination with a lens, we venture to say that the greater part of the mixture is composed of senna leaves. We also detect a little dog grass and a few seeds of an umbelliferous plant, perhaps angelica.

(3076) H. B. P. writes: Will you kindly inform me what number German silver wire to use for resistance box on 110 volt current? I want from 20 to 30 ohms resistance without heating the wire beyond ordi-

nary limit. A. You should speak of a "110 volt circuit," there is no such thing as a "110 volt current." The resistance must exceed the quotient obtained by dividing the resistance of a single lamp by the number of lamps on the leads in question. Otherwise the safety fuses will melt or the house wire become too hot. A 20 ohm resistance will pass 5·5 amperes, and hence should be placed upon at least a ten-lamp lead, or the safety fuses may melt. A German silver wire No. 7 will be of sufficient size for this current, and 3,000 feet will give the desired resistance. The "Arithmetic of Electricity" is now ready for delivery by us, $1 by mail.

(3077) A. R. L. asks whether chloride of silver can be changed to nitrate or metallic silver, and how to do it? A. Yes. Place it in dilute sulphuric acid with some metallic zinc. This will reduce it to metallic silver if enough zinc is added. This may then be washed and dissolved in nitric acid, evaporated to dryness and fused at very low heat to give pure nitrate of silver. The fusion may be dispensed with.

NEW BOOKS AND PUBLICATIONS.

THE ARITHMETIC OF ELECTRICITY. By T. O'Conor Sloane, Ph.D. Pp. 138. 12mo. Norman W. Henley & Co., New York. Price $1.

This little book is a manual of electrical calculations by arithmetical methods, and contains, first of all, an introductory chapter explaining some of the principles of electricity, giving the relations of absolute and practical units, and examples of the principal ones taken from actual objects. The second chapter treats of Ohm's law in a concise manner, giving six different versions of this fundamental theorem. There are chapters on resistance and conductance, with many rules and problems; on potential difference, containing much good information on leads and wiring for arc and incandescent systems; on the measurement of conductors by circular mils and on many other topics; a chapter on the arrangement of battery cells, and general calculations for battery current, treats this subject in full detail. The electro-magnet, dynamos, and motors come in for their share of attention. All the calculations in the book are done arithmetically, algebra being left out entirely. The problems are stated in a series of rules accompanied by examples fully worked out. Each rule is generally followed with a formula embodying its statement. The simple system of calculating dynamos and motors deserves especial notice. The tables of equivalents, wire gauges, and other factors contained by the book are newly calculated and will be found very convenient. This little volume shows a great deal of careful work, and will prove of great value to both the professional and amateur electrician.

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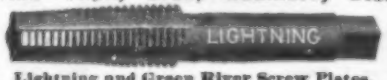

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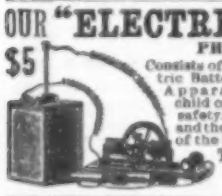

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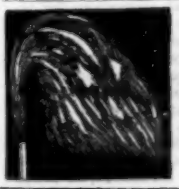

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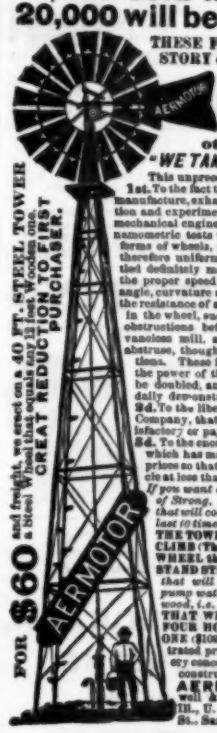

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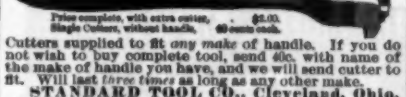

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See illustrated description of Tallapoosa, Ga., in the SCIENTIFIC AMERICAN, May 31, 1890, with two pages of illustrations and description, prepared by a special correspondent after two visits to the city, as well as many other industrial centers in the new South. Since that time the following new industries have been located in this Yankee city of the South.

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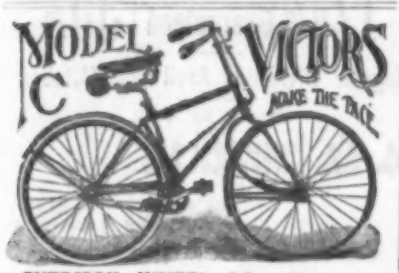

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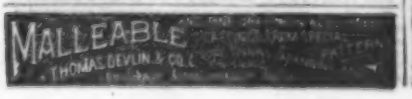

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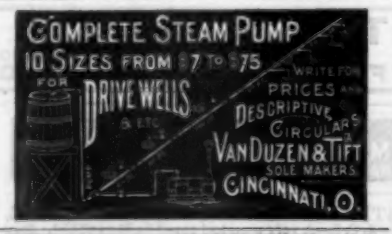
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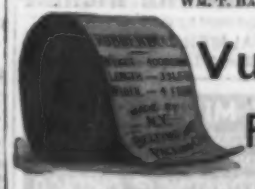

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